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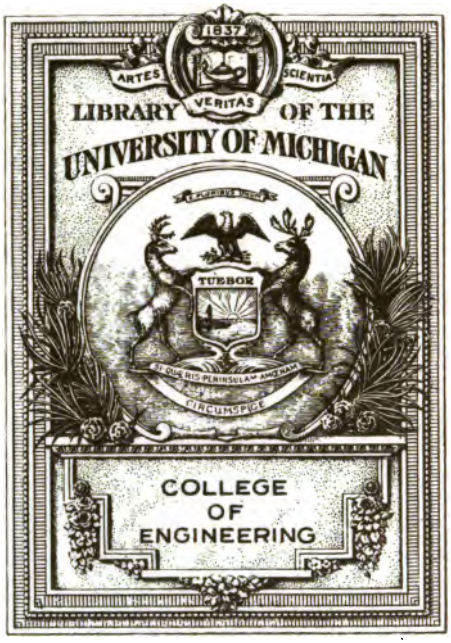
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"Red Books" of the
BRITISH FIRE PREVENTION COMMITTEE—No. 91.
Edited by the Executive.

FIRE TESTS WITH GLASS.

ELECTRO GLAZED CASEMENTS

BY THE

BRITISH LUXFER PRISM SYNDICATE, LIMITED,

LONDON.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897—Incorporated 1899),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE:

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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Sub-Committees comprise Members of the Executive with Assistance from the General Membership.

The Chairman and Hon. Secretary of the Executive are ex officio *members of all Sub-Committees.*

NOTE.

It will be of interest to compare the present with previous tests of electro-glazed casement lights (*see* Publications Nos. 20 and 29).

Such comparison will clearly show the importance of limiting the size of these casement lights to an area of about 2 ft. by 2 ft., *i.e.*, 4 ft. superficial.

It is satisfactory to learn that with casements of this description it is possible to obtain protection to window openings against attacks from outside fires for a period of 45 minutes.

The importance of protection of this nature is shown by the large fires that have occurred during the past year where buildings have been involved by flame entering through the windows.

It is desirable in such windows to make provision by which firemen can get in and out of the premises on fire without destroying them, so as to avoid currents of air by which smoke and fire may be rapidly driven through the building. This is a suggestion for further development.

JAMES SHEPPARD.

LONDON,
February 15th, 1905.

THE GENERAL ARRANGEMENTS FOR TESTS.

(*MEMORANDUM.*)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials, systems of construction, or appliances used in building practice for the detection and extinction of fire.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

As to the Committee's present Testing Station, it comprises a house, standing in its own grounds, near Royal Oak Station, and backing on to the Great Western Railway. The principal building is used for Committee Rooms and laboratory purposes, whilst the gardens are utilised for so-called "full-size" tests.

As to the financial aspect of the station, the establishment expenses are being met by a special subscription. As far as the funds of the committee permit, investigations and experimental tests with ordinary (*i.e.*, not patented) forms of construction are undertaken from time to time and duly reported on. Official tests with patented materials, makers' systems, etc., etc., are subject to a scale of charges, but these charges are so figured as to only just cover the actual cost. The Testing Station is also open to members for such private research work or tests they may desire to undertake.

The services of the members participating in the management of the station, conducting or attending tests, are given entirely gratuitously.

For the Executive,

EDWIN O. SACHS, *Chairman.*

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST NO. 56—JANUARY 18TH, 1905.

ELECTRO GLAZED CASEMENTS

BY THE

THE BRITISH LUXFER PRISM SYNDICATE, LTD.,

LONDON.

OBJECT OF TEST.

To record the effect of a fire of three quarters of an hour's duration at a temperature gradually increasing to 1,500° Fahr. (*815·5° C.*), but not to exceed 1,550° Fahr. (*843.3° C.*), followed by the application of water for two minutes.

Note.—The lights, six in number, were to be in three pairs fitted in two teak frames and one steel frame respectively, each pair of lights being separated by transoms. The electro glazing was to be partly in squares of 4 in. by 4 in. (*·1016 m.* × *·1016 m.*), partly in diamond and fancy patterns.

Each light was to measure 2 ft. by 2 ft. (*0·61 m.* × *0·61 m.*).

Note.—The frames are described as Nos. 1, 2, and 3; Nos. 1 and 3 being teak and No. 2, steel.

SUMMARY OF EFFECT.

The squares of electro glazing in each of the lights commenced to crack immediately after the gas was lit and other squares continued cracking during the test.

In fifteen minutes the glazing in the two teak frames commenced bulging, one (No. 1) towards the fire, and the other (No. 3) from the fire; this bulging increased during the test from ¼ in. (*·0063 m.*) to ½ in. (*·0127 m.*)

The teak frame (No. 1) which was set nearly flush on the fire side was burning freely; the burning subsequently decreased but was renewed at 21 minutes. In 40 minutes the teak transom of this frame was aglow on the side away from the fire.

The glass was not displaced from its electro glazing in any of the lights.

On the application of water at 45 minutes, the whole of the glazing was covered with small hair cracks, presenting a frosted appearance, but was not displaced.

There were indications that fire had passed between the glazing and the wood frames.

The fire did not pass through the glazing.

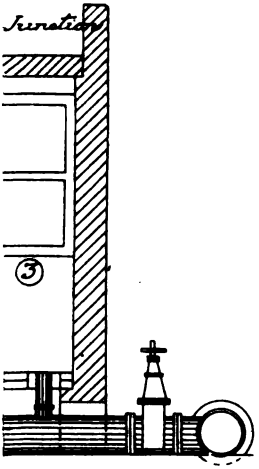
DESCRIPTION OF TESTING PLANT.

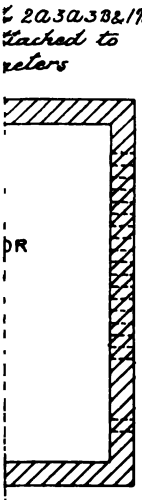
(*See Figs.* 1 *to* 4.)

The Testing Chamber was located at the Committee's Testing Station, being Hut No. 1.

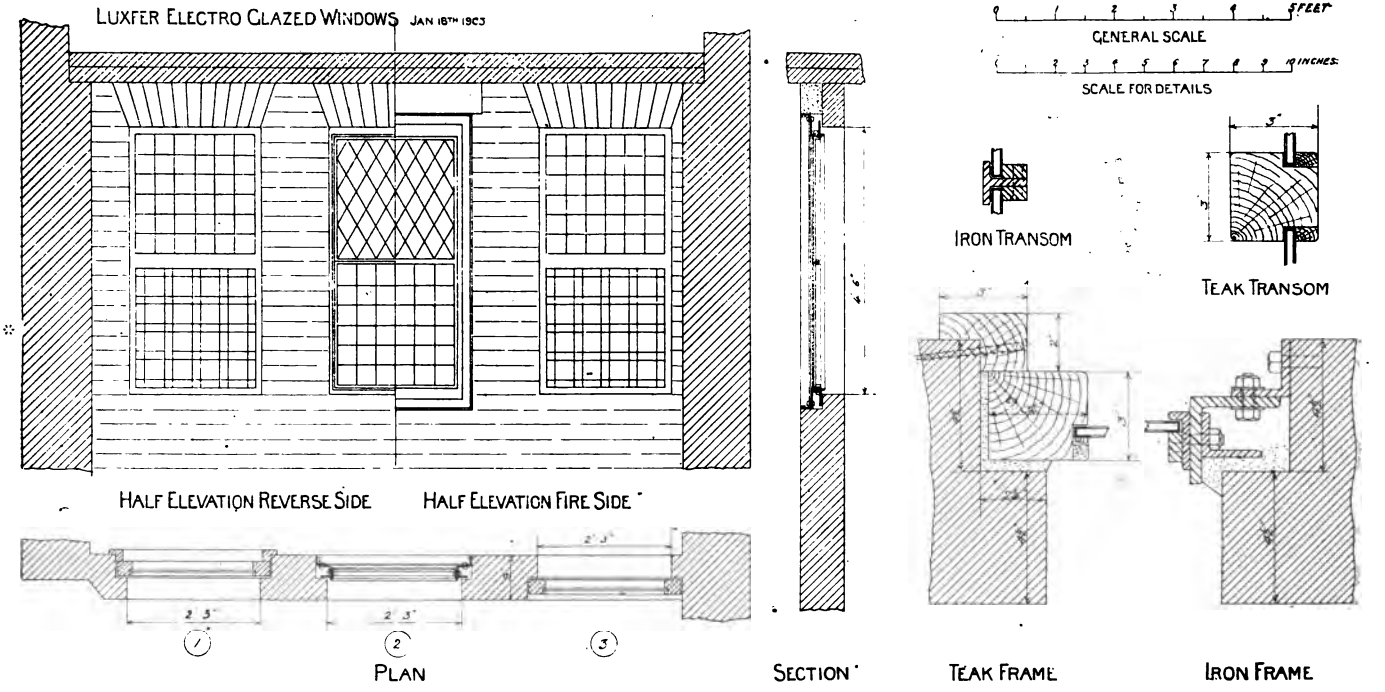
The chamber was constructed as shown of stock brickwork with lime mortar, and measured internally 10 ft. (*3·048 m.*) by 10 ft. (*3·048 m.*)

The ceiling of the hut was 8 ft. 11 in. (*2·72 m.*) above the pavement of the chamber. The ceiling or roof of the chamber was constructed of wood joists placed close together.





FIGS. 5 AND 6. DETAILS OF CASEMENTS.



Figs. 5 AND 6. DETAILS OF CASEMENTS.

(*No.* 1.) (*No.* 2).

Fig. 7. CASEMENTS NOS. 1 AND 2 BEFORE THE TEST (FROM OUTSIDE).

(*No.* 2.) (*No.* 3.)

Fig. 8. CASEMENTS NOS. 2 AND 3 BEFORE THE TEST (FROM OUTSIDE).

The chamber was divided by a 9 in. (*0·229 m.*) wall of brickwork into two compartments, measuring 3 ft. 8 in. (*1·12 m.*) and 5 ft. 7 in. (*1·7 m.*) by 10 ft. (*3·048 m.*). Three openings were formed in this wall in which the casements containing the glazed lights to be tested were fixed.

There was a door opening into the large compartment on the west side, and observation holes for each compartment on the north and south sides, protected by sheet iron covers.

The fuel used was gas produced at the station, the supply being regulated by valves and dampers.

The gas was admitted through a mixing chamber of fire brick into the northern compartment 10 ft. (*3·048 m*). by 3 ft. (*0·914 m.*), indicated on Figs. 1 to 3.

A Roberts-Austin pyrometer was used for recording temperatures; four observation records from points Nos. 1b, 2a, 3a, and 3b, one, *i.e.*, No. 1b, being in the southern compartment and three in the northern compartment, as indicated on Fig. 4.

There were ventilation holes in the upper portion of both the northern and southern walls.

The photographs were taken partly by daylight and partly by flashlight.

The stream of water was applied through a hose and branch with ¾ in. (*·019 m.*) nozzle, and supplied from a small steam fire engine equipped with a pressure gauge.

CONSTRUCTION OF THE CASEMENTS.

See Figs. 5 to 8.

The fixing of the casements in the reveals of the 9 in. wall (*·2549 m.*) was completed on January 13th, 1905.

The glazing in the teak casements Nos. 1 and 3 was

(*No.* 1.) (*No.* 2.)

Fig. 9. CASEMENTS NOS. 1 AND 2 AFTER THE TEST (FROM OUTSIDE).

(*No.* 2.) (*No.* 3.)

Fig. 10. CASEMENTS NOS. 2 AND 3 AFTER THE TEST (FROM OUTSIDE).

secured by teak beads, a cementing material of asbestos being used in place of ordinary putty.

Casement No. 1 was placed on the inner or fire side of the wall the junction of the casement and brickwork being covered by a rebated teak architrave screwed to a concrete fixing brick built into the wall, and Casement No. 3 was fixed on the outer side with a $4\frac{1}{2}$ in. (*·114 m.*) reveal towards the fire.

The upper lights of casements Nos. 1 and 3 were glazed with $\frac{1}{4}$ in. (*·0063 m.*) polished plate glass in 4 in. (*·1016 m.*) squares. In the lower lights the 4 in. (*·1016 m.*) squares were also of $\frac{1}{4}$ in. (*·0063 m.*) polished plate glass and the rectangles were of $\frac{1}{4}$ in. (*·0063 m.*) Luxfer special white glass 4 in. by $1\frac{3}{5}$ ins. (*·1016 × ·039*) and the small squares were of $\frac{1}{4}$ in. (*·0063 m.*) rippled glass $1\frac{3}{5}$ ins. square.

The glazing of casement No. 2 was fixed in a frame of steel angles and steel tee transom bolted together as indicated on Figs. 5 and 6. The upper light was glazed with $\frac{1}{4}$ in. (*·0063*) Luxfer special white glass in diamond-shaped quarries, with 4 in. (*·1016 m.*) sides, the top and bottom angle of each being 60°, the lower light was of $\frac{1}{4}$ in. (*·0063 m.*) polished plate glass in 4 in. (*·1016 m.*) squares similar to the upper lights of Nos. 1 and 3. The glazing was fixed with steel beads screwed to the metal frame and transom bedded with asbestos cement.

All the lights were electro glazed by the British Luxfer Prism Syndicate process.

The margin round each light was of copper channel. Each light showed glazing measuring 2 ft. × 2 ft. (*0·61 × 0·61 m.*).

THE TEST.

On January 18, 1905, the test was undertaken. The following is a log of the test :—

(*No.* 2.)

Fig 11 CASEMENT NO. 2 AFTER THE TEST (FROM FIRE SIDE).

At 3 p.m., the meteorological obervations taken at the Botanic Gardens, Regent's Park, read as follows :—

State of weather, clear ; wind, W.N.W. ; barometer, 29·99 ins. (*0·76 m.*) ; attached thermometer, 38·5° Fahr. (*3·5 C.*) ; wet bulb, 36·5° Fahr. (*2·4 C.*) ; dry bulb, 39·0° Fahr. (*3·8 C.*).

Remarks : Fine day, wind cold.

Observations.	Minutes elapsed.
12.45 p.m. The gas was lighted and the test commenced. Immediately after, squares of glass in each of the six lights commenced to crack; this was more marked in the lower lights.	
1 p.m. The lights in the teak casements Nos. 1 and 3 commenced bulging, No. 1 towards the fire and No. 3 from the fire.	15
1.2 p.m. The teak casement No. 1 was freely burning on the fire side. This subsequently diminished, and afterwards increased.	17
1.20 p.m. Smoke passed round the teak casements into the compartment away from the fire.	35
1.25 p.m. The teak transom of casement No. 1 was aglow on the outside.	40
1.29 p.m. The teak of both casements, Nos. 1 and 3, was burning on the fire side, and the pointing to steel frame No. 2 had partly fallen away on both sides.	44
1.30 p.m. The gas was turned off.	45

Minutes elapsed.

1.31 p.m. Water was turned on with a pressure of about 40 lbs. per square inch on the side of the casements away from the fire. 46

1.33 p.m. Water was turned off. Water was also applied on the fire side to extinguish the burning teak in the casements. 48

No part of the glass was displaced.

No fire or water had passed through the glazing.

TEMPERATURES.

The temperatures as read from the observation record off pyrometer points, Nos. 2a, 3a, 3b, and 1b, were as follows * :—

	Inside.			Outside (in Passage).	
Time.	2a.	3a.	3b.	1b.	Minutes Elapsed.
	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	
12.45 p.m.	—	—	—	—	—
12.47 „	600	700	700	—	2
	(*315·5*)	(*371·1*)	(*371·1*)		
12.50 „	620	740	740	—	5
12.53 „	680	800	810	110	8
12.56 „	680	810	860	200	11
12.59 „	810	1200	1310	200	14
1.2 „	1000	1060	1140	210	17
	(*537·7*)	(*571·1*)	(*615·5*)	(*98·8*)	
1.5 „	1220	1300	1410	140	20
1.8 „	1260	1260	1400	340	23
1.11 „	1320	1360	1460	380	26
1.14 „	1360	1360	1480	420	29
1.17 „	1400	1500	1500	500	32
	(*760*)	(*815·5*)	(*815·5*)	(*260·0*)	
1.20 „	1420	1520	1500	500	35
1.23 „	1430	1480	1480	540	38
1.26 „	1500	1400	1400	550	41
1.29 „	1520	1420	1400	580	44
	(*826·6*)	(*771·1*)	(*760*)	(*340·4*)	

* Degrees in italics are Centigrade.

(*No.* 3.) (*No.* 2.) (*No.* 1.)

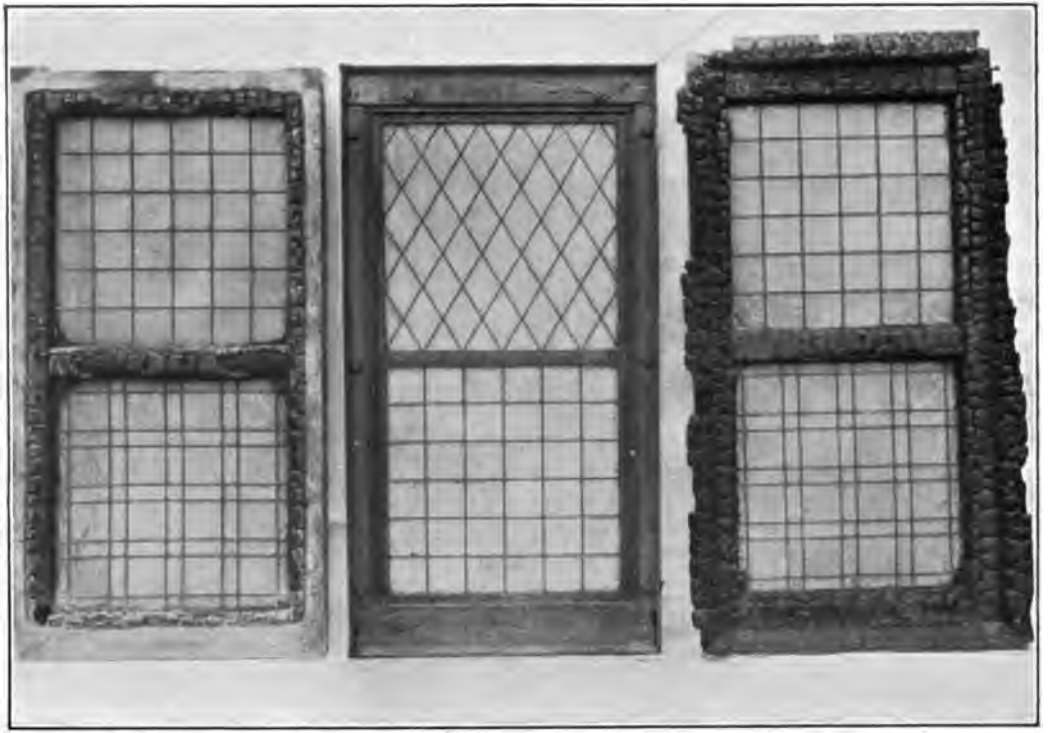


Fig. 12. CASEMENTS NOS. 3, 2, AND 1 TAKEN DOWN AFTER THE TEST (FROM FIRE SIDE).

(*No.* 1.) (*No.* 2.) (*No.* 3.)

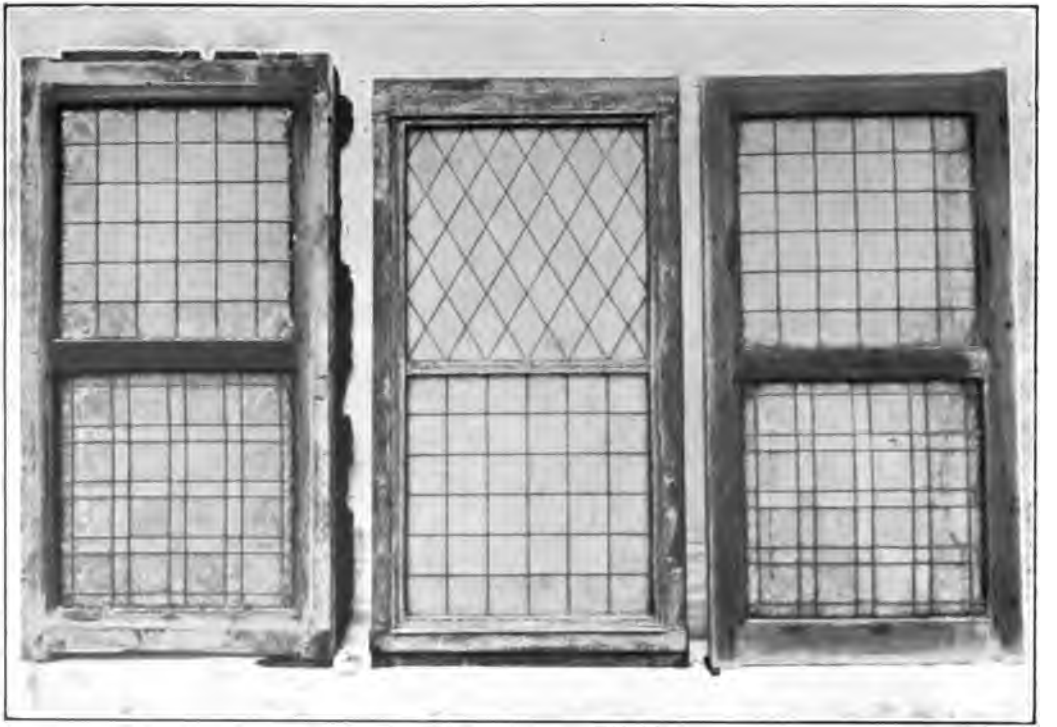


Fig. 13. CASEMENTS NOS. 1, 2, AND 3, TAKEN DOWN AFTER THE TEST (FROM OUTSIDE).

OBSERVATIONS AFTER TEST.—JAN. 19TH, 1905.

(*See Figs.* 9–13.)

FIRE SIDE.

No. 1. Teak Casement fixed flush on fire side:

Architrave around casement charred nearly through. Face of casement and transom charred to a depth of from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. (·*0127* to ·*019 m.*)

No. 2. Steel Frame fixed towards fire side:

Pointing round frame defective and partly fallen. One screw where screwed into concrete brick had split off face of brick.

Holdfasts for keeping frame in position loose.

No. 3. Teak Casement fixed with $4\frac{1}{2}$ in. (·114 m.) *reveals towards fire:*

The face of casement and transom charred to a depth of $\frac{1}{2}$ in. to $\frac{3}{4}$ in. (·*0127 to* ·*019 m.*)

OUTSIDE (AWAY FROM FIRE).

No. 1. Teak Casement:

Lower light bulging inwards about $\frac{1}{4}$ in. (·*0063 m.*)

One square of upper light on bottom row punctured.

The beads were charred where abutting against the glazing except along the bottom bead of lower light.

No. 2. Steel Frame:

Pointing round frame defective otherwise intact.

No. 3. Teak Casement:

Lower light bulged outwards about $\frac{1}{2}$ in. (·*0127 m.*) in centre.

Beads where abutting against glass slightly charred.

GENERAL ARRANGEMENTS.

The Test was carried out according to the procedure laid down by the Executive for investigations of this description, and conducted by a Sub-Committee of the Executive comprising :—

Mr. James Sheppard, A.Inst.E.E. (North British and Mercantile Insurance Co.), *Directing Member.*
Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham).
Mr. J. Herbert Dyer (Vice-President National Fire Brigades' Union).

Mr. A. H. Lister assisted the Sub-Committee.
Mr. H. B. White, M.Inst.E.E., superintended in the Instrument room.

The Executive was represented by :—
Mr. Edwin O. Sachs, F.R.S.Ed. (Chairman).
Mr. Ellis Marsland (District Surveyor, Camberwell).
Mr. Percy Collins.
Mr. Max Clarke, F.R.I.B.A.
Mr. J. W. Restler, M.Inst.C.E. (Metropolitan Water Board).

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Messrs. the British Luxfer Prism Syndicate, Ltd., were represented by :—
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The following visitors attended by special invitation of the Executive :—

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Signed,

For the Sub-Committee conducting the Test :—

JAMES SHEPPARD (Directing Member).

For the General Testing Arrangements Sub-Committee :—

ELLIS MARSLAND.

For the Executive :—

EDWIN O. SACHS.

Published by the Committee as directed by the Executive.

C. F. ADAMI.

Date—February 15th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE-INNES, SON AND CRICK.

Date—February 22nd, 1905.

LISTS OF THE COMMITTEE'S PUBLICATIONS, CONTENTS OF THE COMMITTEE'S JOURNAL, ETC., ARE OBTAINABLE UPON APPLICATION TO THE ASSISTANT SECRETARY, 1 WATERLOO PLACE, PALL MALL, LONDON, S.W.

"*Red Books*" *of the*

BRITISH FIRE PREVENTION COMMITTEE.—No. 92.

Edited by the Executive.

FIRE TESTS WITH PARTITIONS.

A 2½-INCH PARTITION

FORMED WITH

MANTADA PARTITION SLABS,

FIXED BY

THE ADAMANT COMPANY, LIMITED,

LONDON AND BIRMINGHAM.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF

THE BRITISH FIRE PREVENTION COMMITTEE

(*Founded 1897—Incorporated 1899*

1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE:

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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ROBERT VIGERS, Past-President, The Surveyors' Institution.
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SIR JAMES WILLIAMSON, C.B., Director of H.M. Dockyards.
SIR HENRY TRUEMAN WOOD, M.A., Secretary, Society of Arts.

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1, WATERLOO PLACE, PALL MALL, LONDON, S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

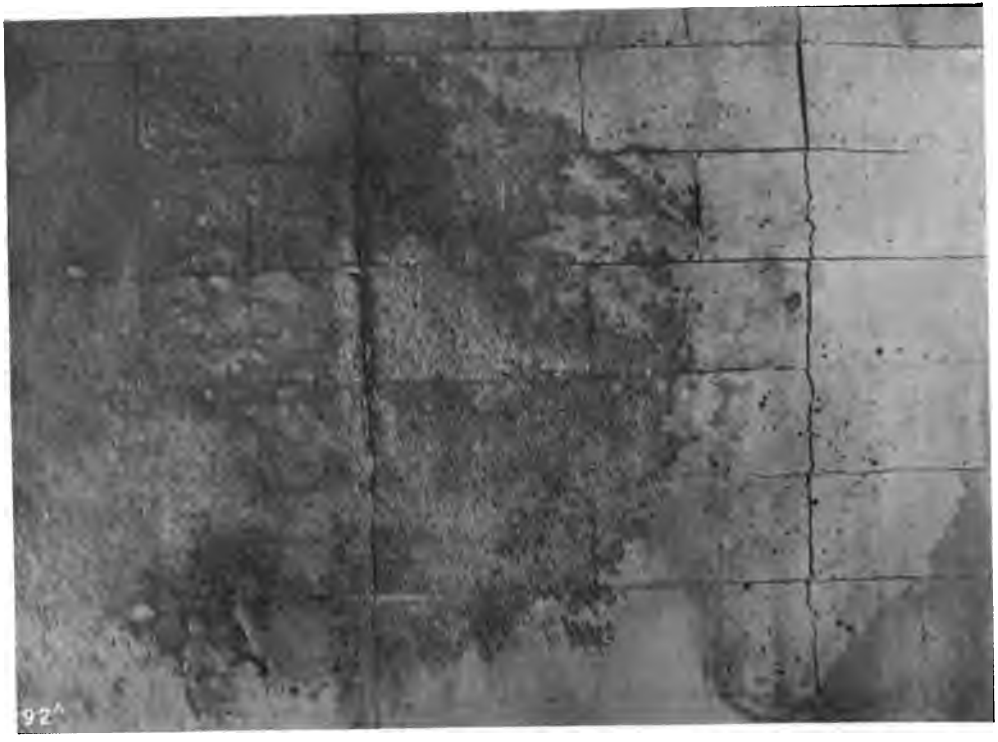

Fig 8. THE PARTITION (FROM INSIDE) AFTER THE TEST.

NOTE.

The test detailed in the following pages is the second test with Mantada slabs. It will be noted that, although the fire and water passed through the partition, it retained its position.

In the attempt to improve upon the previous test by the introduction of iron rods, the result indicates that the quantity of metal was excessive.

ELLIS MARSLAND.

LONDON,
March 15th, 1905.

Fig. 9. THE PARTITION (FROM INSIDE) AFTER THE TEST.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

TEST No. 60—MARCH 8TH, 1905.

A 2½ in. PARTITION

FORMED WITH

MANTADA PARTITION SLABS,

FIXED BY

THE ADAMANT COMPANY, LIMITED,

LONDON AND BIRMINGHAM.

OBJECT OF TEST.

To record the effect of a fire of two and a half hours' duration at a temperature gradually increasing to 1,800° Fahr. (*982·2° C.*), and not to exceed 2,000° Fahr. (*1,093·3 C.*), followed by the application of water for two minutes on the fire side with the view of being classified as affording "Full Protection" (Class A).

Note.—The area of the partition under the above class was to be at least 80 ft. superficial (*7·43 sq. m.*), and the thickness was to be 2½ ins. (*·063 m.*) or under when finished.

Note.—The time allowed for the construction and drying of the partition was fourteen days.

SUMMARY OF TEST.

After 53 minutes the partition commenced to bulge inwards, and continued to do so to the end of the test. The maximum deflection was 4⅜ ins. (*·111 m.*).

After 100 minutes a vertical crack appeared in the centre of a slab in the 6th course 4 ft. (*1·219 m.*) from the north end of passage, and gradually extended upwards to the 8th course and downwards to the 3rd course This crack gradually increased in width, and eventually fire and smoke passed through.

On water being applied on the inside it came through the various open joints on the passage side.

The partition remained in position at the conclusion of the test.

DESCRIPTION OF TESTING PLANT.

(*See Figs. 1 to 4.*)

The Testing Chamber used was located at the Committee's Testing Station, and was known as "No. 3 Hut."

The hut was constructed of stock bricks, with lime mortar, and measured 10 ft. by 10 ft. (*3·048 m. × 3·048 m.*).

The ceiling was 9 ft. 4 in. (*2·87 m.*) above the pavement of the hut, and was constructed of concrete.

The door opening in the wall measured 2 ft. by 6 ft. 6 in. (*·61 × 1·98 m.*), and was open during the test.

The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

The hut was divided as shown on plan, the partition being constructed from north to south, the full width and height of the hut, leaving the passage on the outside 1 ft. 9 in. (*0·53 m.*) wide.

The gas was admitted through two mixing chambers of fire-brick, each 8 ft. 1 in. by 3 ft. 3 in. (*2·46 m. × ·99 m.*).

Two Roberts-Austen pyrometers were used for recording temperatures, one to take a continuous record from point No. 5, and one being used for the observation records at points No. 1, 2, 3, 4, and 5. Points No. 1, 4, 5, were inside the chamber, and No. 2 and 3 in the passage.

There were two observation holes, one in the north

and one in the south wall, and two small observation holes in the west wall.

The stream of water was applied to the inside face of the partition through the observation hole on the south side, by a branch with a $\frac{3}{4}$ in. (·019 *m.*) nozzle, supplied from a small steam fire engine.

CONSTRUCTION OF THE PARTITION.

(*See Figs. Nos.* 1 *to* 5.)

On February 20th to 23rd, 1905, the partition was erected.

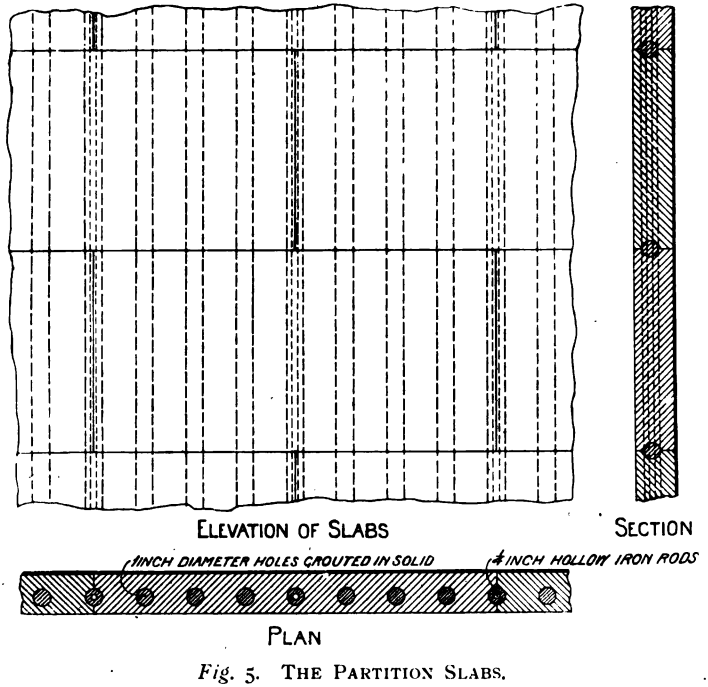

Fig. 5. THE PARTITION SLABS.

The slabs forming the partition were built up in courses 12 in. high (·304 *m.*) on a course of stock bricks on the floor of the hut and carried up to the underside of the

concrete ceiling, the height of the partition being 9 ft. 2 in. (*2·79 m.*). The partition, including plastering, was $2\frac{1}{2}$ in. thick (*·063 m.*), built of slabs 24 in. by 12 in. by $2\frac{3}{8}$ in. (*·61 × ·31 × ·06 m.*).

The slabs were perforated vertically with holes 1 in. (*·025 m.*) in diameter, and at each end there was a semi-circular groove corresponding to half of one of the 1 in. (*·025 m.*) holes. In the vertical joints in the positions shown iron tubes $\frac{1}{4}$ in. internal diam. were inserted through the partition, and these were connected together by means of screwed joints. All the vertical holes were run in solid with plaster.

The partition was plastered on the fire side with adamant plaster $\frac{1}{8}$ in. thick (*·003 m.*).

The passage side of the partition was not plastered.

A coke fire was lighted in the hut on February 23rd, and kept burning each day until March 7th.

The materials and manufacture of the slabs is stated by the makers to be a secret process.

There were fillets of adamant plaster 3 in. (*·076 m.*) by 1 in. (*·025 m.*) round the ceiling, walls, and floor on both sides of the partition.

THE TEST.

On March 8th, 1905, the test was undertaken. The following is a log of the test :—

At 3 p.m. the meteorological observations taken at the Botanic Gardens, Regent's Park, read as follows :—

"State of weather, cloudy; Wind, S.S.E.; Barometer, 29·99 inches; attached thermometer, 48° Fahr.; Wet Bulb, 43° Fahr.; Dry Bulb, 47° Fahr. Remarks: Fine afternoon."

At 3.15 p.m. the gas was lighted.

Observations on the Outside.

(*See Fig.* 6.)

		Minutes Elapsed.
3.30 p.m.	Hair cracks appeared along joints between 5th and 6th course. Partition began to steam in two places along horizontal joint between 4th and 5th course.	15
3.34 p.m.	Partition steaming at several joints over surface.	19
3.40 p.m.	Partition steaming freely all over.	25
4.25 p.m.	Short streak of distilled tar appeared on face of 7th course.	70
4.45 p.m.	Hair cracks appeared along joint between 4th and 5th course. Also hair crack appeared along joint between 2nd and 3rd course and a glow of fire was seen through about 4 feet from N. end of passage.	90
4.55 p.m.	A vertical crack appeared across centre of 6 course, 4 feet (*1·22 m.*) from N. end of passage and extended upwards to course 7 and downwards to course 5.	100
4.59 p.m.	The above-mentioned crack extending upwards and downwards and also widening, and glow from fire seen through it.	104
5.1 p.m.	Glow from fire seen through joint between 4th and 5th course about 6 feet (*1·83 m.*) from N. end of passage.	106
5.3 p.m.	Vertical joint on 7th course 4 feet (*1·22 m.*) from N. end discoloured by smoke passing through.	108
5.7 p.m.	Glow from fire seen through vertical crack on courses 5, 6 & 7, 4 feet (*1·22 m.*) from N. end of passage.	112
5.9 p.m.	Vertical crack extending down 4th course as above.	114

		Minutes Elapsed.
5.10 p.m.	Smoke coming through the vertical crack in 5th course.	115
5.15 p.m.	Spots of distilled tar appearing on face of partition in various places. The vertical crack in courses 5, 6, and 7 increasing to a width of about ¼ in. (·006 *m.*)	120
5.16 p.m.	Horizontal joint opening between 3rd and 4th courses.	121
5.27 p.m.	The vertical crack in courses 5, 6, and 7 extending up to the 8th course.	132
5.30 p.m.	The vertical cracks in courses 5, 6, and 7 extending down to the 4th course, and fire coming through this crack.	135
5.32 p.m.	The horizontal joint between 4th and 5th courses blackened by smoke for about two-thirds its length.	137
5.35 p.m.	Glow from fire seen along horizontal joint between 2nd and 3rd courses, and gradually increasing.	140
5.40 p.m.	Glow from fire showing along horizontal joint between 7th and 8th courses.	145
5.45 p.m.	Gas turned off.	150
5.46 p.m.	Water applied through ¾ in. jet to fire side of partition, the water passing through some of the joints and running down the face of the partition on the passage side.	151
5.48 p.m.	Water turned off. The partition remained in position.	153

OBSERVATIONS ON THE INSIDE.

3.30 p.m.	Black spots all over surface of partition and small streaks of black liquid running down from same in some places.	15
3.45 p.m.	Slight cracking of the horizontal jointing of slabs from 3rd course upward.	30

Fig. 6. THE PARTITION (FROM OUTSIDE) DURING THE TEST AFTER 112 MINUTES.

Fig. 7. THE PARTITION (FROM OUTSIDE) AFTER THE TEST.

		Minutes Elapsed
3.53 p.m.	The black spots appear to have blown off like ordinary blowing in plaster.	38
4.5 p.m.	Bad crack in horizontal joint between 4th and 5th course.	50
4.25 p.m.	Slight cracks on the face of the plastering where the flames strike it.	70
5.45 p.m.	Cracks appearing in vertical jointing of courses, particularly in 5th, 6th, 7th, and part of 8th course, 4 feet (*1·22 m.*) from N. end, and other cracks in horizontal joints increasing.	90
5.5 p.m.	Vertical crack above mentioned extending through 4th course.	110
5.20 p.m.	Vertical crack above mentioned increasing in width and extending through 3rd course and great part of 2nd course.	125
5.46 p.m.	On the application of water the plaster fell off where struck by the jet. The iron rod in the vertical crack above mentioned was exposed and the vertical crack extended the whole height of partition excepting the top course.	151

TABLE showing BULGING of partition inwards during the test.

Time.	Bulging.	Minutes elapsed.
3.15 p.m.	nil	0
4.8 „	$\frac{1}{8}$ inch (*·003 m.*)	53
4.15 „	$\frac{1}{4}$ „ (*·006*)	60
4.25 „	$\frac{3}{8}$ „ (*·009 m.*)	70
4.35 „	$\frac{7}{8}$ „ (*·022 m.*)	80
4.47 „	$1\frac{5}{8}$ „ (*·041 m.*)	92
4.59 „	$2\frac{3}{8}$ inches (*·060 m.*)	104
5.5 „	$2\frac{5}{8}$ „ (*·066 m.*)	110
5.9 „	$2\frac{7}{8}$ „ (*·073 m.*)	114
5.15 „	$3\frac{1}{4}$ „ (*·082 m.*)	120
5.23 „	$3\frac{1}{2}$ „ (*·088 m.*)	128
5.30 „	$3\frac{7}{8}$ „ (*·098 m.*)	135
5.35 „	$4\frac{1}{4}$ „ (*·108 m.*)	140
5.43 „	$4\frac{3}{8}$ „ (*·111 m.*)	148

TABLE showing TEMPERATURES on the face of the partition on the outside taken with a thermometer during test.

Time.	Temperature.	Minutes elapsed.
3.28 p.m.	58° F.	13
3·35 „	88° F.	20
3·40 „	92° F. (*33·3° C.*)	25
3·45 „	96° F.	30
3·50 „	110° F. (*43·3° C.*)	35
3 55 „	104° F.	40
4.0 „	110° F. (*43·3° C.*)	45
4·47 „	115° F.	92
5.0 „	135° F. (*57·2° C.*)	105

TABLE of TEMPERATURES from Pyrometer Points No. 1, 2, 3, and 4.

	INSIDE.		OUTSIDE.		
TIME.	No. 1.	No. 4.	No. 2.	No. 3.	MINUTES ELAPSED.
	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	
3.25 p.m.	1100	1150	—	—	10
3.30 „	1250	1200	—	—	15
	(*667·6 C.*)	(*648·8 C.*)			
3.35 „	1310	1350	—	—	20
3.40 „	1500	1510	—	—	25
3.45 „	1580	1550	—	—	33
	(*860·0*)	(*843·3*)			
3.50 „	1600	1550	-	—	35
3.55 „	1680	1550	—	—	40
4.0 „	1700	1500	—	—	45
	(*926·6*)	(*815·5*)			
4.5 „	1700	1700	—	—	50
4.10 „	1750	1650	—	—	55
4.15 „	1700	1680	—	—	60
	(*926.6*)	(*915·5*)			
4.20 „	1720	1680	—	—	65
4.25 „	1730	1700	—	—	70
4.30 „	1800	1760	—	—	75
	(*982·2*)	(*960·0*)			
4.35 „	1850	1840	—	—	80
4.40 „	1860	1880	—	—	85
4.45 „	1880	1860	—	—	90
	(*1026·6*)	(*1015·5*)			
4.50 „	1930	1880	—	—	95
4 55 „	1910	1900	100	102	100
5.0 „	1940	1880	100	105	105
	(*1060·0*)	(*1026·6*)	(*37 7*)	(*40·5*)	
5.5 „	1990	1840	105	105	110
5.10 „	1995	1980	105	107	115
5.15 „	1950	1980	110	110	120
	(*1065·5*)	(*1082·2*)	(*43 3*)	(*43·3*)	
5.20 „	1950	2050	120	125	125
5.25 „	1820	1860	130	145	130
5.30 „	1810	1850	150	180	135
	(*987·7*)	(*1010·0*)	(*65·5*)	(*82·2*)	
5.35 „	1850	1900	190	205	140
5.40 „	1900	1950	210	215	145
5 45 „	1940	2000	265	280	150
	(*1060·0*)	(*1093·3*)	(*129·4*)	(*137·7*)	

Degrees in italics are Centigrade.
No record was obtained from Pyrometer Point No. 5.

OBSERVATIONS AFTER TEST.

March 11, 1905 (see Figs 7–9).

OUTSIDE.

The bulging of the partition reduced to $3\frac{1}{8}$ inches (*0·079 m.*). The vertical crack 4 feet (*1·22 m.*) from the N. End of passage extended from the 2nd to the 8th course, and its greatest width was $\frac{1}{4}$ of an inch (*0·006 m.*).

The horizontal joints between the 8th and 9th course and the 7th and 8th course, and between the 4th and 5th course, were blackened by the smoke coming through.

Streaks of distilled tar were distributed over the face of the partition.

The partition was rigid and secure.

A vertical crack extended from the top to the bottom of the partition 2 feet (*·61 m.*) from the S. End of passage.

INSIDE.

The face of the partition where struck by the water had the plaster washed away and the face of the slabs was eroded for an area of about 30 square feet (*2·78 □ m.*).

The remaining portion of the plaster face was cracked in the direction of the vertical and horizontal joints of the slabs.

The horizontal and vertical joints of the slabs were opened.

A vertical crack about $\frac{1}{2}$ inch wide (*·012 m.*) extended from the floor to the ceiling 4 feet (*1·22 m.*) from the N. End of hut, exposing the iron tube, which was scaled.

A vertical crack about $\frac{1}{4}$ in. wide (*·006 m.*) extended from floor to ceiling 2 feet (*·61 m.*) from the S. End.

The plaster was disintegrated.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and conducted by a Sub-Committee of the Executive, comprising:—

Mr. Ellis Marsland (District Surveyor, Camberwell), Directing Member.

Mr. Max Clarke, F.R.I.B.A.

The late Mr. Ellis H. Pritchett, F.R.I.B.A., F.S.I. (Chief Officer, Swindon Fire Brigade).

Mr. Oswald C. Wylson, F.R.I.B.A.

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Council was represented by :—

Mr. H. H. Collins, F.R.I.B.A. (District Surveyor Eastern Division City of London).

The Executive was represented by :—

Mr. Edwin O. Sachs, F.R.S.Ed. (Chairman).

Mr. James Sheppard, A.Inst.E.E. (Surveyor North British and Mercantile Insurance Co.).

Mr. J. H. Dyer (Vice-President National Fire Brigades' Union).

The General Body of Members was represented by :—

Lieut.-Col. Geo. W. Dixon, V.D. (Vice-President National Fire Brigades Union); Messrs. E. J. A. Fulkes (Royal Insurance Company); Matt. Garbutt, A.R.I.B.A.; F. W. Hamilton, A.R.I.B.A. (District Surveyor, Fulham); Robert P. Notley, F.R.I.B.A. (District Surveyor, Bethnal Green); Frank B. Passmore, and J. J. Thomas (Chief Superintendent Liverpool Fire Brigade).

Messrs. Adamant & Co. were represented by :—

Messrs. A. J. Ash; E. C. Bolton; A. Hall; R. W. Palk; J. Wilkinson.

The following visitors attended at the Testing Station by special invitation of the Executive during the Testing Operations of March 8th :—

Messrs. the Danish Consul-General (J. Faber) ; J. Gavey, C.B. (Engineer-in-Chief), W. Brown and W. Alex. Moir (of the General Post Office) ; Captain Hamilton, R.N. (Chief Officer), Sidney Gamble, F.S.I. (Divisional Officer) and Lieut. Sladen, R.N. (Divisional Officer) of the London Fire Brigade ; A. C. Booth ; H. F. Dale ; H. K. Dyson ; H. A. McFarran (Assistant Engineer, H.M. Office of Works) ; E. Henius (Copenhagen) ; Arthur B. Hayward ; Wm. de Jongh ; — Jackson ; J. Lassen ; N. G. Pennington ; J. Pulleine ; J. Redgrave (H.M. Superintending Inspector of Factories, Home Office) ; W. A. Rees (Liv., Lond. and Gl. Ins. Co.) ; H. Rallings ; Geo. Stubbings (Superintendent of Fire Brigade, Great Eastern Railway) ; J. W. Ward ; Hugh P. Whall ; and R Young.

Signed,

For the Sub-Committee conducting the Test, and the General Testing Arrangements Sub-Committee :

ELLIS MARSLAND.

For the Executive :

EDWIN O. SACHS.

Published by the Committee as directed by the Executive.

CHARLES ADAMI (*Assist. Secretary*).

Date—April 12th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE-INNES, SON & CRICK (*Solicitors*).

Date—April 22nd, 1905.

LISTS OF THE COMMITTEE'S PUBLICATIONS, CONTENTS OF THE COMMITTEE'S JOURNAL, ETC., ARE OBTAINABLE UPON APPLICATION TO THE ASSISTANT SECRETARY, 1, WATERLOO PLACE, PALL MALL, LONDON, S.W.

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The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

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The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

COUNCIL.

Chairman of the Executive:

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HORACE S. FOLKER, F.A.I., Gen. Hon. Sec. Nat. Fire Brigades' Union.

Bankers:

LONDON AND SOUTH WESTERN BANK,
Regent Street, W.

Testing Station:

WESTBOURNE LODGE, BAYSWATER, W.

Offices:

1, WATERLOO PLACE, PALL MALL, LONDON, S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 9. THE PARTITION, VIEW AFTER TEST (FROM FIRE SIDE).

NOTE.

It will be observed that this partition, although standing well through the fire test, failed on the application of water through a $\frac{3}{4}$-in. jet at 40 lbs. pressure.

The partition was weakened during the fire test by the carbonising of the wood slips which should have held it together. It would therefore appear that some other method should be devised, and as the proprietors of the partition are applying for further tests, perhaps this defect may be remedied.

ELLIS MARSLAND.

LONDON,
March 2nd, 1905.

THE GENERAL ARRANGEMENTS FOR TESTS.

(*MEMORANDUM.*)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials, systems of construction, or appliances used in building practice.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

As to the Committee's present Testing Station, it comprises a house, standing in its own grounds, near Royal Oak Station, and backing on to the Great Western Railway. The principal building is used for Committee Rooms and laboratory purposes, whilst the gardens are utilised for so-called "full-size" tests.

As to the financial aspect of the station, the establishment expenses are being met by a special subscription. As far as the funds of the committee permit, investigations and experimental tests with ordinary (*i.e.*, not patented) forms of construction are undertaken from time to time and duly reported on. Official tests with patented materials, makers' systems, etc., etc., are subject to a scale of charges, but these charges are so figured as to only just cover the actual cost. The Testing Station is also open to members for such private research work or tests they may desire to undertake.

The services of the members participating in the management of the station, conducting or attending tests, are given entirely gratuitously.

For the Executive,

EDWIN O. SACHS, *Chairman.*

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST No. 57—JANUARY 18TH, 1905.

A 2½ in. PARTITION

FORMED WITH

MANTADA PARTITION SLABS,

FIXED BY

THE ADAMANT COMPANY, LIMITED,

LONDON AND BIRMINGHAM.

OBJECT OF TEST.

To record the effect of a fire of two and a half hours' duration at a temperature gradually increasing to 1,800° Fahr. (*982·2° C.*), and not to exceed 2,000° Fahr. (*1,093·3 C.*), followed by the application of water for two minutes on the fire side with the view of being classified as affording "Full Protection" (Class A).

Note.—The area of the partition under the above class was to be at least 80 ft. superficial (*7·43 sq. m.*), and the thickness was to be 2½ ins. (*·063 m.*) or under when finished.

Note.—The time allowed for the construction and drying of the partition was fourteen days.

SUMMARY OF TEST.

During the fire test the partition buckled outwards ¾ in. (*·019 m.*).

No fire or smoke passed through the partition.

The recorded temperature in the passage on the out-

side face of the partition at no time exceeded 220° Fah. (*104·4° C.*).

On the application of water about 20 ft. sup (*1·8 sq. m.*) of the partition fell.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The Testing Chamber used was located at the Com mittee's Testing Station, and was known as "No. 3 Hut."

The hut was constructed of stock bricks, with lim mortar, and measured 10 ft. by 10 ft. (*3·048 m.* × *3·048 m.*)

The ceiling was 9 ft. 4 in. (*2·87 m.*) above the pavement of the hut, and was constructed of concrete.

The door opening in the wall measured 2 ft. by 6 ft. 6 in. (*·61* × *1·98 m.*) and was open during the test.

The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

The hut was divided as shown on plan, the partition being constructed from north to south, the full width and height of the hut, leaving the passage on the outside 1 ft. 9 in. (*0·53 m.*) wide.

The gas was admitted through two mixing chambers of fire-brick, each 8 ft. 1 in. by 3 ft. 3 in. (*2·46 m.* × *·99 m.*).

Two Roberts-Austen pyrometers were used for recording temperatures, one to take a continuous record from point No. 5, and one being used for the observation records at points No. 1, 2, 3, and 4. Points No. 1, 4, 5, were inside the chamber, and No. 2 and 3 in the passage.

There were two observation holes, one in the north, and one in the south wall, and two small observation holes in the west wall.

The stream of water was applied to the inside face of the partition through the observation hole on the south side, by a branch with a $\frac{3}{4}$ in. (*·019 m.*) nozzle, supplied from a small steam fire engine.

CONSTRUCTION OF THE PARTITION.

(*See Figs. Nos.* 1 *to* 6.)

On January 6th and 7th, the partition was erected.

The slabs forming the partition were built on a course of stock bricks on the floor of the hut, and carried up to the underside of the concrete ceiling, the height of the

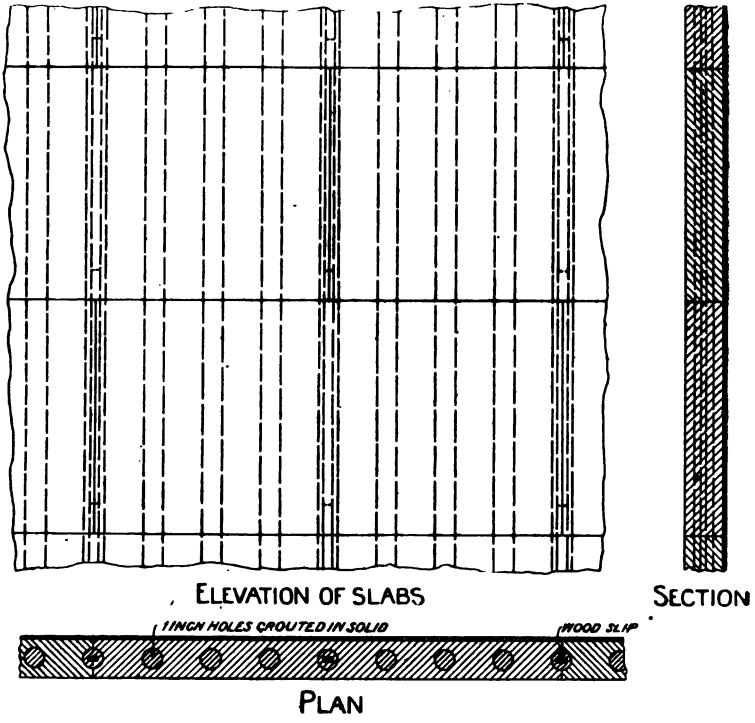

Fig. 5. THE PARTITION SLABS.

partition being 9 ft. 2 in. (*2·79 m.*) The partition including plastering, was $2\frac{1}{8}$ in. thick (*·054 m.*), built of slabs 24 in. by 12 in. by 2 in. (*·61 × ·31 × ·051 m.*)

The slabs were perforated vertically with holes 1 in. (*·025 m.*) in diameter and at each end there was a semicircular groove corresponding to half of one of the 1 in. holes. In the vertical joints wood slips $\frac{1}{2}$ in. (*·012 m.*) ×

¼ in. (·006 *m.*) were run in with adamant plaster. There were similar wood slips run into the centre hole of each slab. All the vertical holes were run in solid with plaster.

The partition was plastered on the fire side with adamant plaster ⅛ in. thick (·003 *m.*)

The passage side of the partition was not plastered.

A coke fire was lighted on Monday, January 9th, and kept burning during each day until the 17th.

The materials and manufacture of the slabs is stated by the makers to be a secret process.

There were fillets of adamant plaster, 3 in. (·076 *m.*) by 1 in. (·025 *m.*), round the ceiling, walls, and floor on both sides of the partition.

THE TEST.

On January 18th, 1905, the test was undertaken. The following is a log of the test :—

At 3 p.m. the meteorological observations taken at the Botanic Gardens, Regent's Park, read as follows :—

"State of weather, clear ; Wind, W.N.W. ; Barometer, 29·99 inches (·76 *m.*) ; attached thermometer, 38·5° Fahr. (3·4 *C.*) ; Wet Bulb, 36·5° Fahr. (2·3 *C.*) ; Dry Bulb, 39° Fahr. (3·8 *C.*) Remarks : Fine day, wind cold."

At 1.30 p.m. the gas was lighted.

Observations on the Outside. (*See Fig.* 7.)	Minutes Elapsed.
1.35 p.m. Partition begining to steam along 8th horizontal joint.	5
1.36 p.m. Partition steaming along various horizontal joints.	6
1.51 p.m. Temperature against face of partition 90° Fahr. (32·2 *C.*)	21
2.0 p.m. Temperature against face of partition 100° Fahr. (37·7 *C.*)	30
2.50 p.m. Partition had bulged towards passage side, ½ in. (·013 *m.*) Temperature against face of partition 105° Fahr. (40·5 *C.*)	80

		Minutes Elapsed.
2.57 p.m.	Temperature against face of partition 120° Fahr. (*48·8 C.*)	87
3.6 p.m.	Partition had bulged towards passage side, $\frac{5}{8}$ in. (*·016 m.*)	96
3.30 p.m.	Partition had bulged towards passage side, $\frac{3}{4}$ in. (*·019 m.*)	120
3.37 p.m.	Temperature against face of partition 130° Fahr. (*54·4 C.*)	127
3.47 p.m.	Scarcely any steam coming from joints.	137
3.51 p.m.	Temperature against face of partition 160° Fahr. (*71·1 C.*)	141
3.55 p.m.	Temperature against face of partition 175° Fahr. (*79·4 C.*)	145
3.57 p.m.	Temperature against face of partition 200° Fahr. (*93·3 C.*)	147
4.0 p.m.	Temperature against face of partition 220° Fahr. (*104·4 C.*)	150

Distilled tar from the materials in the composition of the partition ran in short streaks down the outer face of the partition during the latter part of the test.

	Observations on the Inside.	Minutes Elapsed.
1.34 p.m.	A large part of the setting coat of plaster had fallen off.	4
1.44 p.m.	Still more of the setting coat fallen.	14
3.16 p.m.	Small portions of the plaster jointing of the slabs falling out.	106
4.0 p.m.	Gas turned off.	150
4.1 p.m.	Water turned on to the inside face of the partition for a space of two minutes, when about 20 ft. super of the partition fell, the remaining parts being insecure.	151
4.3 p.m.	Water turned off and test concluded.	

side face of the partition at no time exceeded 220° Fahr. (*104·4° C.*).

On the application of water about 20 ft. super. (*1·8 sq. m.*) of the partition fell.

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The Testing Chamber used was located at the Committee's Testing Station, and was known as "No. 3 Hut."

The hut was constructed of stock bricks, with lime mortar, and measured 10 ft. by 10 ft. (*3·048 m. × 3·048 m.*).

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The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

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The stream of water was applied to the inside face of the partition through the observation hole on the south side, by a branch with a $\frac{3}{4}$ in. (*·019 m.*) nozzle, supplied from a small steam fire engine.

Fig. 8. THE PARTITION (FROM INSIDE) AFTER THE TEST.

OBSERVATIONS AFTER TEST

On January 19th, 1905 (*see Figs.* 8 *and* 9).

INSIDE.—About 20 ft. superficial (*1·8 sq. m.*) of the partition had fallen. The face of the remaining portion where struck by the water was eroded ½ in. (*·012 m.*).

The face of the partition, where not struck by water showed the plaster faced cracked over the surface and along the line of joints.

The remainder of the partition was in a very insecure condition.

The wooden slips connecting the slabs were carbonised.

OUTSIDE.—The portion of the partition that remained retained the same appearance as at the conclusion of the test so far as the surface was concerned, but the joints were open in some cases.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and conducted by a Sub-Committee of the Executive, comprising :—

Mr. Ellis Marsland, District Surveyor, Camberwell (*Directing Member*).
Mr. Max Clarke, F.R.I.B.A.

Mr. A. H. Lister assisted the Sub-Committee.
Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Executive was represented by :—

Mr. Edwin O. Sachs, F.R.S.Ed. (Chairman).
Mr. Percy Collins.
Mr. J. Herbert Dyer (Vice-President, National Fire Brigades' Union).
Mr. J. W. Restler, M.Inst.C.E. (Met. Water Board).
Mr. James Sheppard (Nth. Brit. & Merc. Ins. Co.).

The General Body of Members was represented by :—

Mr. S. Flint Clarkson, F.R.I.B.A. (District Surveyor, Kensington) ; Mr. Ed. Dru Drury (District Surveyor, St. Margaret's, Westminster) ; Mr. E. J. A. Fulkes (Royal Insurance Co.) ; Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham) ; Capt. J. H. Thompson (H.M. Chief Inspector of Explosives, Home Office) ; Mr. Oswald C. Wylson, F.R.I.B.A.

The Adamant Co. were represented by :—Messrs. Alfred J. Ash, C. E. Bolton, A. Hall, W. Mack, R. Shaw, and John Wilkinson.

The following visitors attended by special invitation of the Executive :—Messrs. W. D. Belcher, S. W. Bowyer, H. C. Carter, H. K. Dyson, Harley M. Grellier, G. Spencer Hoffman, H. King (Royal Exchange Assurance Co.), S. Marsland, J. J. Pulleine, and Robert Ray.

Signed,

For the Sub-Committee conducting the Test :
ELLIS MARSLAND, *Directing Member.*

For the General Testing Arrangements Sub-Committee :
MAX CLARKE.

For the Executive :
EDWIN O. SACHS.

Published by the Committee as directed by the Executive.
C. ADAMI.

Date—April 12th, 1905.

Verified a true copy of the Report ordered to be published.
ROSE-INNES, SON AND CRICK.

Date—April 22nd, 1905.

LISTS OF THE COMMITTEE'S PUBLICATIONS, CONTENTS OF THE COMMITTEE'S JOURNAL, ETC., ARE OBTAINABLE UPON APPLICATION TO THE ASSISTANT SECRETARY, 1, WATERLOO PLACE, PALL MALL, LONDON, S.W.

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"Red Books" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 94.

Edited by the Executive.

FIRE TESTS

WITH

AUTOMATIC FIRE ALARM SYSTEMS

AN AUTOMATIC FIRE ALARM SYSTEM

BY

THE AUTOPYROPHONE COMPANY, LIMITED,

COPENHAGEN.

The Report of the Committee

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897—Incorporated 1899),
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Three Shillings and Sixpence.

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Fig. 7. INDICATORS IN SMALL COMMITTEE ROOM.

NOTE.

The importance of Fire Brigades receiving the earliest possible notice of the outbreak of fire in their respective districts is universally recognised.

Having this object in view, Fire Brigade authorities responsible for the protection of important centres provide and maintain throughout their territory numerous public fire-alarm points, with extensions in some cities inside private premises, having electric connection with Brigade Stations, for use by watchmen or other persons who may discover outbreaks of fire.

The provision in a similar manner of thermostats or automatic fire detectors throughout private establishments, having electric connection with suitable indicators, preferably placed in the nearest Fire Brigade Station, simply constitutes a further development of the fire alarm systems above described.

In the automatic fire detector, consisting of a "differential" and a "fixed" part, known as the "Autopyrophone," which has been subjected to the tests described in the following report, pressure of vapour from a volatile spirit, resulting from expansion under increase of temperature, is applied to a column of mercury in a glass tube, causing displacement of the mercury with the consequent opening of a closed electric circuit, this being arranged so as to close a secondary open circuit by which signals are given for transmission to any desired position.

With every provision for securing notice automatically

SOTHERAN

of faults or other contingencies that may arise in connection with electric circuits, as used in the systems under review, it is nevertheless desirable to make daily tests to definitely ascertain that every part is in working order.

It is also necessary that every signal or call that may be given should receive instant attention.

The importance of this was shown by the Baltimore conflagration of the 7th and 8th of February, 1904. The Hurst "Stores," where this conflagration originated, were equipped with automatic alarms, from which a trouble or danger signal was received, but as the establishment at the time was closed without watchman or other person on the premises, this first signal, which was really the commencement of a Fire-call, was disregarded. Twenty-five minutes later a definite Fire-call was received from the automatic alarms, and promptly responded to by the Fire Brigade, who were then (owing to the great extent and nature of the building with its open stair and lift shafts, light wells and inflammable contents part of which under the action of heat freely gave off gases or vapours leading to an explosion sufficient to break the window glass) unable to control the fire, which ultimately spread over 140 acres covered with buildings, causing a loss of ten millions sterling.

JAMES SHEPPARD.

1, WATERLOO PLACE,
LONDON, S.W.
April, 1905.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TESTS NOS. 58 & 59. FEBRUARY 21 & 22, 1905.

AN AUTOMATIC FIRE ALARM SYSTEM

BY

THE AUTOPYROPHONE COMPANY, LTD.,

COPENHAGEN.

OBJECT OF TESTS.

TESTS A^1, A^2, A^3.—To ascertain the temperature and time at which danger and fire calls would be given by the Autopyrophone Detectors on indicators, after the temperature had been artificially raised by gas stoves at different rates of increase—to simulate a smouldering fire.

TESTS B^1, B^2, B^3.—To ascertain the temperature and time at which danger and fire calls would be given by the Autopyrophone Detectors on indicators and bells, after a fire has commenced, causing a moderate increase of temperature, and also the amount of damage shown when the fire has been extinguished by hand appliances after a lapse of three minutes from the first fire-call.

TESTS C.—To ascertain the working of provisions for avoiding a fire-call from any fault on the system; and also if all faults that may arise will at once give a trouble-call, or can be readily discovered by testing the plant; further, if in any exceptional case a danger-call is caused by some unforeseen occurrence, other than a fire, *i.e.*, exceptional heating of short duration, there will be time enough to discover and remedy such occurrence before a fire-call would be given.

NOTES.

TESTS A^1, A^2, A^3 were made with three double or "differential and fixed" Detectors, ***a, b, c,*** "quick," "medium," and "slow," respectively, each consisting of two parts (see Appx.—A and B, in Figs. 1–3), in the Lounge on the First Floor of the Committee's Offices at the Testing Station, batteries and indicators being in the same room (see Figs. 3 and 4). The "fixed" part of each Detector was set to give Danger-call at about 95° F. (*35° C.*), and Fire-call at about 112° F. (*44·4° C.*).

TESTS B^1, B^2, B^3.—Tests B^1, B^2 were made with three single "differential" Detectors, ***d, e, f,*** "quick," "medium," and "slow," respectively, and one single "fixed" Detector ***g*** (see Appx.—A and B, in Figs. 1–3), and Test B^3 with the three double or "differential and fixed" Detectors, ***a, b, c,*** and one single "fixed" Detector, g^x, in Hut No. 2, the batteries, indicators and bells being in the small Committee-room on the Ground Floor of the Committee's Offices at the Testing Station (see Figs. 5 and 6). Detectors ***g*** and g^x were set to give Danger-call at about 130° F. (*54·4° C.*), and Fire-call at 150° F. (*65·5° C.*).

TESTS C were made with four double or "differential and fixed" Detectors, ***h, j, k,*** and ***l,*** in the Committee-rooms (see Fig. 5), the location of the indicators and bells being as for Tests B^1, B^2, B^3. Each Detector was in all respects similar to ***b*** above described.

SUMMARY OF APPLIANCES TESTED AND OF RESULTS OBTAINED.

TEST A^1. *February 21st from 3.30 p.m. to 5.30 p.m.*—Three Detectors, ***a, b, c,*** were installed near the ceiling of the room known as the Lounge on the First Floor of the Committee's Offices and subjected to an increasing heat by means of gas stoves to simulate actual fire.

Temperature of room at commencement, 54° F. (*12·2° C.*) Temperature increased at a rate not exceeding 1° F. (*0·5° C.*) per minute by the lighting of gas stoves, as shown to be necessary (see Figs. 3 and 4). The double or "differential and fixed" Detectors ***a, b, c,*** each consisting of two parts (see Appx. A and B, Figs. 1 and 3) gave Danger

and Fire Signals on the indicator in the times and at the temperatures as follows :—

Double "Differential and Fixed" Detector.	Time elapsed after commencement of test, and temperature at which the different signals were given.				Minutes elapsed between Danger and Fire Signals.
	Danger Signal.		Fire Signal.		
	Minutes.	Temperature.	Minutes.	Temperature.	
a	106	98° F. (36·6° C.)	120	112° F. (44·4° C.)	14
b	98	92° F. (33·3° C.)	120	112° F. (44·4° C.)	22
c	106	98° F. (36·6° C.)	119	111° F. (43·8° C.)	13

TEST A2. February 22nd, from 2.12 p.m. to 2.34 p.m.— With the same Detectors. Temperature of room at commencement, 47° F. (8·3° C.). Temperature increased at the rate of about 5° F. (2·2° C.). by the lighting of gas stoves. The Detectors *a*, *b*, *c*, gave Danger and Fire Signals on the indicators in the times and at the temperatures as follows :—

Double "Differential and Fixed" Detector.	Time elapsed after commencement of test, and temperature at which the different signals were given.				Minutes elapsed between Danger and Fire Signals.
	Danger Signal.		Fire Signal.		
	Minutes.	Temperature.	Minutes.	Temperature.	
a	3	6,° F. (18·3° C.)	22	126° F. (52·2° C.)	19
b	13	108° F. (42·2° C.)	21	125° F. (51·6° C.)	8
c	14	112° (44·4° C.)	20	124° F. (51·1° C.)	6

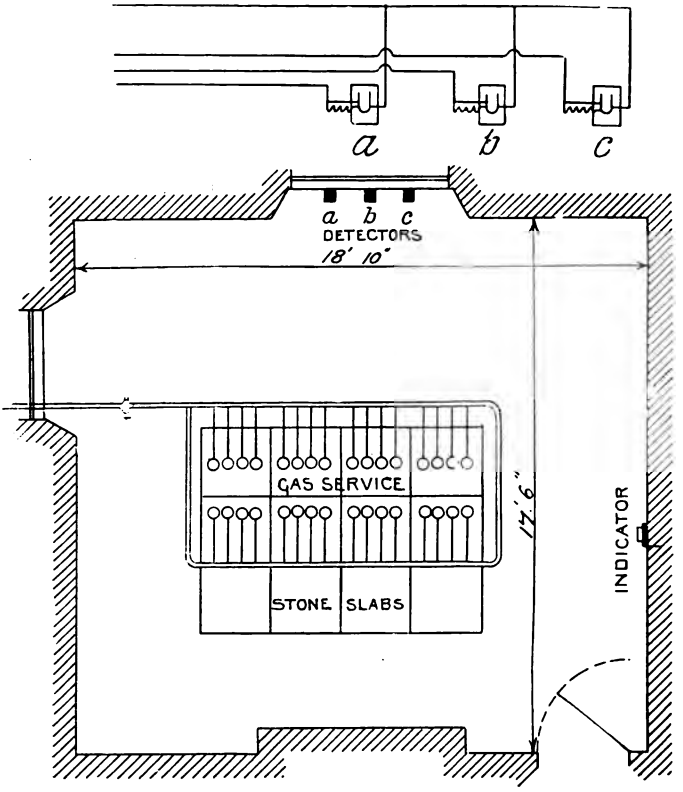
TEST A3. February 22nd, from 3.37 p.m. to 3.50 p.m.— With the same Detectors. Temperature of room at commencement, 52° F. (11·3° C.). Temperature increased at the rate of about 12° F. (6·1° C.) per minute. The

Detectors gave Danger and Fire Signals on the indicators in the times and at the temperatures as follows :—

Double "Differential and Fixed" Detector.	Time elapsed after commencement of test, and temperature at which the different signals were given.				Minutes elapsed between Danger and Fire Signals.
	Danger Signal.		Fire Signal.		
	Minutes.	Temperature.	Minutes.	Temperature.	
a	1	59° F. (15·0° C.)	4	92° F. (33·3° C.)	3
b	3	83° F. (28·3° C.)	13	125° F. (51·6° C.)	10
c	6	106° F. (41·1° C.)	12	123° F. (50·5° C.)	6

Fig. 3. ROOM KNOWN AS "LOUNGE" (FITTED WITH GAS STOVES FOR TESTS A^1, A^2, A^3).

TEST B[1]. *February 22nd, from 2.48 p.m.*—Four Detectors, ***d, e, f, g,*** were installed near the ceiling of Hut No. 2 and subjected to test by actual fire (see Figs. 5 to 9). Three, ***d, e, f,*** were "differential" Detectors, and one, ***g,*** "fixed" Detector, each consisting of one part only (see Appx. A and B, Figs. 1 and 3). Temperature of Hut when the fire was started at 2.48 p.m., 50° F. (*10° C.*). Danger and Fire Signals were given by the several detectors in the following times and temperatures:—



PLAN OF LOUNGE.

Fig. 4. ARRANGEMENTS FOR TESTS A[1], A[2], A[3].

Single "Differential" and "Fixed" Detector.	Time elapsed after commencement of test, and temperature at which the different signals were given.				Seconds elapsed between Danger and Fire Signals.
	Danger Signal.		Fire Signal.		
	Seconds.	Temperature.	Seconds.	Temperature.	
e	90	111° F. (43·8° C.)	No Fire Signal	Maximum temperature reached, 119° F. (48·3° C.)	—
g	—				
f	105	110° F. (43·3° C.)			
d	80	105° F. (40·5° C.)	120	112° F. (44·4° C.)	40

Fire was extinguished three minutes after Fire Signal from Detector *d* with half a bucket of water through hand pump (see Figs. 8 and 9).

TEST B². February 22nd, from 3.26 p.m.—This test practically repeated the previous test, the same Detectors being used. Temperature of Hut when fire was started at 3.26 p.m. was 60° F. (15·5° C.). Danger and Fire Signals were given in the following times and temperatures :—

Single "Differential" and "Fixed" Detector.	Time elapsed after commencement of test, and temperature at which the different signals were given.				Seconds elapsed between Danger and Fire Signals.
	Danger Signal.		Fire Signal.		
	Seconds.	Temperature.	Seconds.	Temperature.	
e	73	117° F. (47·2° C.)	120	130° F. (54·4° C.)	47
g	155	140° F. (60·0° C.)	No Fire Signal	Maximum temperature reached, 158° F. (70·0° C.	—
f	85	132° F. (55·5° C.)	130	140° F. (60·0° C.)	45
d	70	130° F. (54·4° C.)	92	135° F. (57·2° C.)	22

Fire was extinguished three minutes after Fire Signal from Detector ***d***, by being knocked out—water not being used (Fig. 10).

TEST B3. February 22nd, from 4.51 p.m.—In this test the three double "differential" and "fixed" Detectors ***a, b, c,*** previously used in Tests A^1, A^2, A^3, were used with the addition of a single "fixed" Detector g^x, similar to the fixed part of detectors ***a, b, c,*** but set to give Danger-call at about 130° F. (*54·4° C.*), and a Fire-call at about 150° F. (*65·5° C.*). Temperature of Hut at commencement of test (4.51 p.m.), 60° F. (*15·5° C.*). Danger and Fire Signals were given in the following times and temperatures :—

Detector.	Time elapsed after commencement of test, and temperature at which the different signals were given.				Seconds elapsed between Danger and Fire Signals.
	Danger Signal.		Fire Signal.		
	Seconds.	Temperature.	Seconds.	Temperature.	
b (dble. dif. & fixed)	86	127° F. (*52·7° C.*)	130	150° F. (*65·6° C.*)	44
g^x (sgl. fixed)	100	135° F. (*57·2° C.*)	140	151° F. (*66·1° C.*)	40
c (dble. dif. & fixed)	80	125° F. (*51·6° C.*)	100	139° F. (*59·4° C.*)	20
a (dble. dif. & fixed)	93	132° F. (*55·5° C.*)	120	147° F. (*63·8° C.*)	27

Fire was extinguished three minutes after the Fire Signal from Detector ***c*** with half a bucket of water through a hand-pump (Fig. 11).

TESTS C. February 22nd and March 8th.—Four "differential and fixed" Detectors, ***h, j, k. l,*** were installed in the Ground Floor Committee-rooms, and the system subjected to examination in accordance with the object of test.

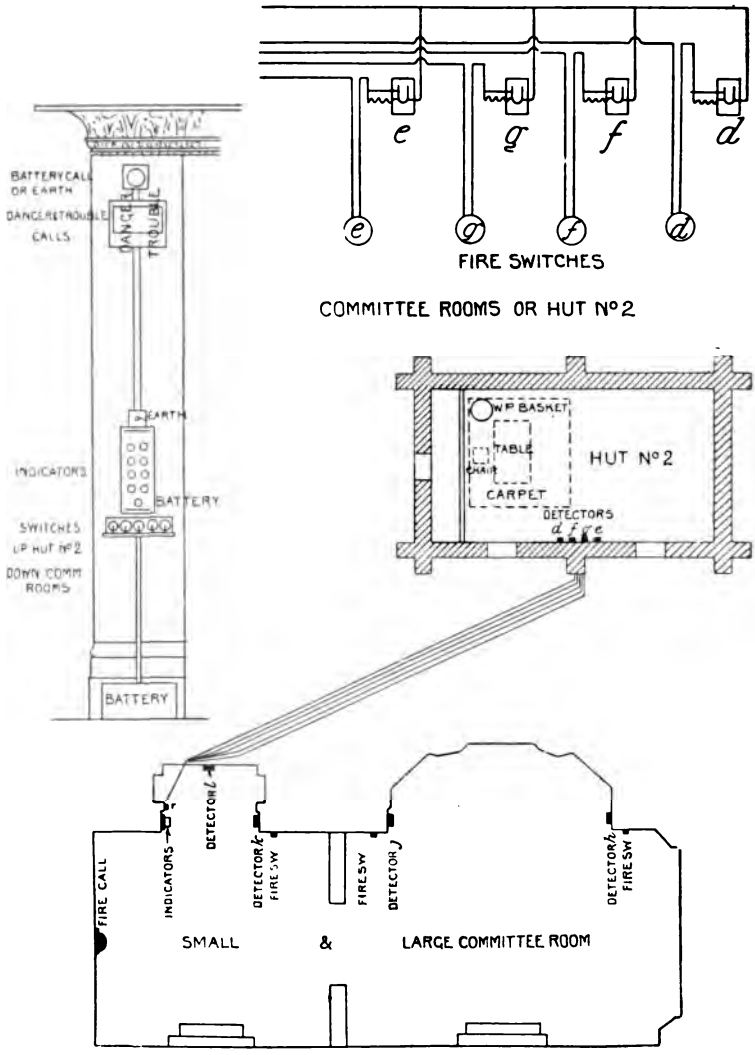
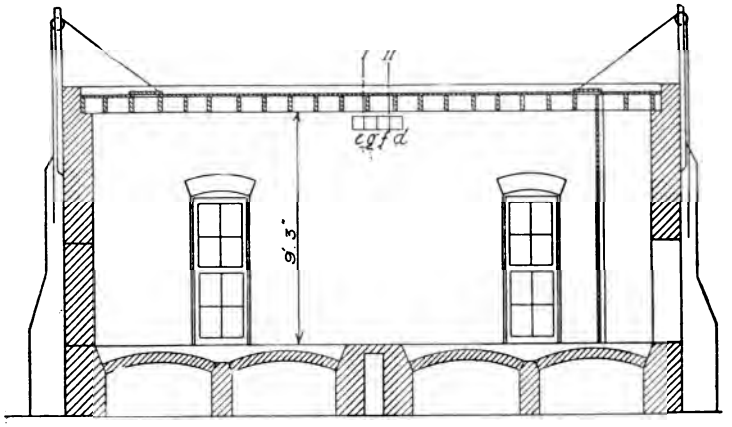
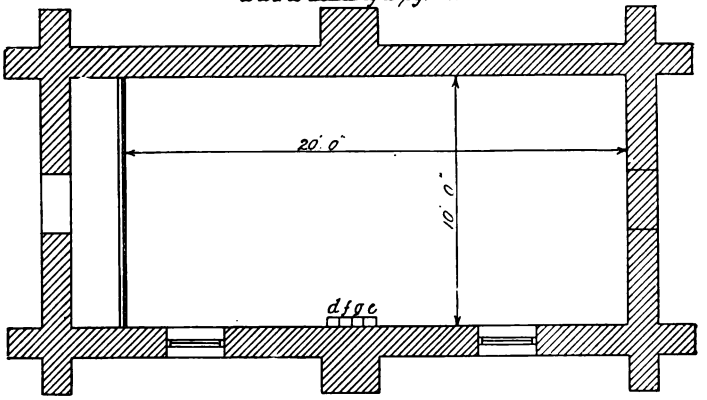


Fig. 5. ARRANGEMENTS FOR TESTS B^1, B^2, B^3, AND C.



LONGITUDINAL SECTION

NOTE The points marked I & II are thermo junctions attached to wires leading to pyrometers



PLAN

Fig. 6. THE TESTING CHAMBERS FOR TESTS B^1, B^2, B^3.

Fig. 8. TESTING CHAMBER PRIOR TO TEST B[1].

Fig. 9. TESTING CHAMBER AFTER TEST B[1].

Fig. 10. TESTING CHAMBER AFTER TEST B^2.

Fig. 11. TESTING CHAMBER AFTER TEST B^3.

**

A fall of voltage in the batteries caused by placing in series with them a resistance equal to 45 ohms, operated the battery trouble indicator, and with a resistance of 50 ohms additional, all the Danger indicators fell.

On making a break in the circuit by a switch, the trouble indicators fell. Connecting the primary circuit to Earth caused the "Earth Indicator" to fall.

A test as to a "short" in the primary closed circuit caused the battery trouble indicator to fall after a lapse of about 40 minutes.

DESCRIPTION OF TESTING ARRANGEMENTS AND APPLIANCES SUBMITTED FOR TEST.

TESTS A^1, A^2, $A3$, *in First Floor Room.*—These tests were made in the room known as the Lounge on first floor of the Committee's Offices at the Testing Station (see Fig. 4), the room measuring about 18 ft. 10 in. by 17 ft. 6 in. (*5·74* × *5·33 m.*) and 11 ft. (*3·35 m.*) high.

Three double "differential and fixed" Detectors, ***a***, ***b***, ***c***, were installed under the ceiling over east window, each connected by electric conductors to a separate relay on the indicator board on south wall in the same room (see Figs. 3 and 4).

Current at a pressure of about 8 volts was obtained from six (No. 2 mark F.S.) dry cell batteries in series.

The temperature of the room was increased by using a set of thirty-two Bunsen stoves, connected by means of 1½ in. pipe to the gas service, each stove capable of separate regulation, and the whole set governed from a main stop valve (see Fig. 4).

Each of the three double "differential and fixed" Detectors consisted of two parts (see Appx. A and B, Fig. 1) a "differential" part, to operate for rates of increase of temperature, and a "fixed" part to operate on a temperature at which the Detector may be set being reached.

As regards the "differential" part:—

Detector ***a***, described as "quick" designed for premises where there is no artificial heating, and intended to act on a slow rate of increase of temperature of over an average of 1° Fah. per minute.

Detector ***b***, described as "medium," designed for normal conditions, and similarly intended to act on a moderate rate of increase of temperature of over an average of 6° Fah. per minute.

Detector ***c***, described as "slow," designed for special purposes, such as drying-rooms, etc., and intended to act on a rapid rate of increase of temperature of over an average of 12° Fah. per minute.

As regards the "fixed" part, all three Detectors, ***a***, ***b***, ***c***, were set to give the "Danger-call" at about 95° F. (*35° C.*), and the Fire-call at about 112° F. (*44·4° C.*)

The temperatures of operation vary somewhat in different tests, depending on local conditions to which the Detectors may be subject during the test.

In each case the tests were continued until both the "Danger" and "Fire-call" had been given from each Detector.

Temperature readings were taken at minute intervals. Thermometers with Centigrade readings were used, and upon verification were found to be ·09° C. above the Kew standard.

TEST A[1].—For this test the rate of increase of temperature was a low one, not exceeding an average of 1° F. (*0·5° C.*) per minute.

TEST A[2].—For this test the rate of increase of temperature was a moderate one, about 5° F. (*2·8° C.*) per minute, and not exceeding an average of 6° F. (*3·3° C.*) per minute.

TEST A[3].—For this test the rate of increase of temperature was a rapid one, but not exceeding an average of 12° F. (*6·7° C.*) per minute.

TESTS B^1, B^2, B^3 *in Hut No. 2.*—Four Detectors (see Fig. 6) were installed near to each other on the centre of the west wall of Hut No. 2, close under the ceiling, each Detector being connected by electric conductors to separate relays on the indicator board in the small Committee-room on the ground floor.

Hut No. 2 was constructed, as shown in Fig. 6, of stock brick and lime mortar, and measured 22 ft. 3 in. × 10 ft. (*6·78 × 3·05 m.*), internally, reduced by wood partition to 20 ft. × 10 ft. (*6·1 × 3·05 m.*). The soffits of the joists of the ceiling over this hut were 9 ft. 6 in. (*2·6 m.*) above the floor. The two door openings on the west side were fitted with glazed doors.

For each test the hut was fitted up to represent a factory pay-office, furnished with table, chairs, waste-paper basket, carpet, and office utensils, and in Test B^2 and B^1 a lighted mineral oil lamp was placed on the table, and this was broken for Test B^3.

In order to simulate an accidental fire, the paper basket was fired in Test B^1 and B^2 with a match, and in Test B^3 by breaking the lighted mineral oil lamp, and accelerating the outbreak by lighting the waste-paper basket.

Three single differential Detectors ***d, e, f,*** and a single fixed Detector ***g,*** were used for the first two tests. For the third test the double "differential and fixed" Detectors, ***a, b, c,*** from Tests A^1, A^2, A^3, were again used, and in addition a single "fixed" Detector, g^x, similar to the "fixed" part of ***a, b, c.***

This Detector g^x consisted of a "fixed" part only, arranged to give a Danger-call at about 130° F. (*54·4° C.*), and a Fire-call at about 150° F. (*65·5 C.*).

Two Roberts-Austen pyrometers were used for recording the temperatures, one point (No. 1) being between indicators ***e*** and ***g,*** and the other (No. 2) between ***f,*** and ***d,*** in Tests B^1 and B^2, in which position they remained for Test B^3.

TEST C. In Ground Floor Committee Rooms.—The Committee's rooms comprise two rooms connected by a large opening, the larger measuring 24 ft. by 17 ft. 6 in. (*7·315 × 5·33 m.*), and the smaller 19 ft. by 17 ft. 6 in.

Fig. 12. SMALL COMMITTEE ROOM (FITTED FOR TEST C).

(*5·8 × 5·33 m.*), the height of both being 11 ft. 11 in. (*3·6 m.*).

Four Detectors ***h, j, k,*** and ***l,*** were installed under the ceiling in the two Committee-rooms as shown on plan (Fig. 5), and each connected by electric conductors to a

separate relay on the indicator board in the small Committee room (see Figs. 5 and 12).

All four Detectors consisted of a "differential" and a "fixed" part, and were of the "normal" type as regards sensitiveness as Detector ***b*** in Tests A^1, A^2, A3, and B3. Each Detector representing any number of detectors in series on the same group.

On each group there was a fire switch, by the use of which a Fire-call can be given as soon as there has been a Danger-call from any one of the detectors in either of the groups; but if not used the "Fire-call" would be given automatically if the temperature continues to increase.

The indicator board consisted of the four relays for the four groups, one relay for the battery, and one relay for earth leakage (Figs. 5 and 7).

The various calls were a Danger-call, a Trouble-call, a battery or earth leakage call and a Fire-call, which latter is intended to be transmitted automatically or manually to a fire station.

LOGS OF TESTS.

(See Figs. 3 to 12.)

The Logs of the different tests are as follows:

TEST A^1, *21st February, 1905, 3.30 p.m.*—In room known as the Lounge, on first floor of the Committee's offices at the Testing Station.

Three double "Differential" Detectors ***a, b, c,*** each consisting of both "differential" and "fixed" parts were placed near the ceiling as before described with thermometers close to Detectors. Indicators, bells and battery in same room.

Detector ***a***, "quick"—***b***, "medium"—***c***, "slow," as far as regards the "differential" parts.

The "fixed" parts of all three Detectors set to operate the "Danger-call" at about 95° F. (35° C.), and the "Fire-call" at about 112° F. (44·4° C.).

Temperature of room 54° F. (*12·2 C.*), raised less than 1° F. (*0·5 C.*) per minute.

Time	Temperature.		Signals.		Time	Temperature.		Signals.	
Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.	Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.
0	54					71			
	54					72			
	54					72			
	(*12·2° C.*)					73			
	55					73			
	55	1 Gas stove alight				73			
					50	74	0·4		
	55					(*23·3° C.*)	(*0·2° C.*)		
						74			
	56	2 Gas stoves				75	9 Gas stoves		
	56	alight					alight		
	57					75			
	57					75			
10	58	0·4				75	10 Gas stoves		
	(*14·4° C.*)	(*0·2° C.*)					alight		
	58					76			
	58	3 Gas stoves				76			
		alight				77			
	58					77			
	58				60	77	0·3		
	59	4 Gas stoves				(*25° C.*)	(*0·15° C.*)		
		alight				78			
	59					78	11 Gas stoves		
	60						alight		
	61					78			
	63					79			
20	63	0·5				79			
	(*17·2° C.*)	(*0·28° C.*)				79			
	64					79	12 Gas stoves		
	65						alight		
	65					80			
	66					80			
	66				70	81	0·3		
	66					(*27·1° C.*)	(*0·15° C.*)		
	66					82			
	67	5 Gas stoves				82			
		alight				82	13 Gas stoves		
	67						alight		
30	68	0·5				83			
	(*20·0° C.*)	(*0·28° C.*)				84			
	68					84	14 Gas stoves		
	68						alight		
	68					85			
	68					85			
	68					85			
	68				80	85	0·4		
	68	6 Gas stoves				(*29·4° C.*)	(*0·2° C.*)		
		alight				86			
	69					86	15 Gas stoves		
	69	7 Gas stoves					alight		
		alight				86			
40	70	0·2				87			
	(*21·1° C.*)	(*0·1° C.*)				87			
	70					87			
	71	8 Gas stoves				87	16 Gas stoves		
		alight					alight		
	71					88			
						88			

Time	Temperature.		Signals.		Time	Temperature.		Signals.	
Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.	Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.
90	88	0·3				98		Detector *a*	
	(31·1° C.)	(0·13° C.)				98		*c*	
	89					99			
	89					100			
	89					101			
	90				110	(38·3° C.)	0·8 (0·45° C.)		
	91					102			
	91					103			
	92					103			
	92		Detector *b*			105			
	92					106			
	93					108			
100	(33·8° C.)	0·5				109			
	93	(0·28° C.)				110			
	94					111			Detector *c*
	94				120	112	1·1		*a-b*
	95					(44·4° C.)	(0·61° C.)		
	96					114			

Note.—According to the testor the "Danger" and "Fire-calls" were given in each case from the "fixed" part of the detectors.

TEST A[2]. *February 22nd, 2.12 p.m.*—Detectors as in Test A[1] in same room. Temperature of room 47° F. (*8·3 C.*) raised at rate of about 5° F. (*2·8 C.*) per minute.

Time	Temperature.		Signals.		Time	Temperature.		Signals.	
Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire	Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.
0	47					68			
	(8·4° C.)					69			
	48				4	70	6·0		
	49					(21·2° C.)	(3·4° C.)		
	49					71			
	50					72			
	50					72			
1	51	4·0				73			
	(11·1° C.)	(2·2° C.)				74			
	52				5	76	6·0		
	53					(24·4° C.)	(3·4° C.)		
	54					76			
	56					76			
	57					77			
2	58	7·0				78			
	(14·4° C.)	(3·9° C.)				78			
	59				6	79	3·0		
	60					(26·2° C.)	(1·7° C.)		
	60					80			
	62					81			
	63					81			
3	64	6·0	Detector			82			
	(18·2° C.)	(3·4° C.)	*a*			83			
	66				7	83	4·0		
	66					(28·1° C.)	(2·2° C.)		
	67					84			

Time	Temperature.		Signals.		Time	Temperature.		Signals.	
Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.	Mins. elapsed.	° F.	Rate of Increase per min. ° F.	Danger.	Fire.
	85				15	114	2·0		
	85					(45·4° C.)	(1·1° C.)		
	86					115			
	87					115			
8	87	4·0				116			
	(30·4° C.)	(2·2° C.)				116			
	88					117			
	88				16	117	3·0		
	89					(47·2° C.)	(1·7° C.)		
	89					118			
	90					118			
9	90	3·0				118			
	(32·4° C.)	(1·7° C.)				118			
	91					119			
	93				17	119	2·0		
	94					(48·2° C.)	(1·1° C.)		
	94					119			
	95					119			
10	95	5·0				120			
	(35° C.)	(2·8° C.)				120			
	97					120			
	98				18	121	2·0		
	99					(49·2° C.)	(1·1° C.)		
	99					121			
	100					—			
	101	6·0				121			
11	(38·2° C.)	(3·4° C.)				121			
	101					121			
	102				19	122	1·0		
	103					(50·0° C.)	(0·5° C.)		
	103					122			
	104					122			
12	105	4·0				122			
	(40·4° C.)	(2·2° C.)				122			
	106					123			
	107				20	123	1·0		Detector *c*
	107					(50·4° C.)	(0·5° C.)		
	107					124			
13	108	3·0	Detector			124			
	(42·1° C.)	(1·7° C.)	*b*			124			
	108					124			
	109					124			
	109				21	125	2·0		Detector *b*
	110					(51·3° C.)	(1·1° C.)		
	110					125			
14	112	4·0	Detector			125			
	(44·0° C.)	(2·2° C.)	*c*			126			
	112					126			
	112					126			
	113				22	126	1·0		Detector *a*
	114					(52·2° C.)	(0·5° C.)		
	114					126			

Note.—According to the testor the "Danger call" was given by "differential" part of ***a***. Other "danger calls" and all "fire calls" were given by the "fixed" part of the detectors.

TEST A[3], *February 22nd.*—Detectors as in Tests A[1] and A[2] in same room. Temperature of room 52° F. (11·2° C.), raised at rate of about 12° F. (6·7 C.) per minute.

Time	Temperature.		Signals.		Time	Temperature.		Signals.	
Mins. elapsed.	F.	Rate of Increase per min F.	Danger	Fire.	Mins. elapsed.	F.	Rate of Increase per min. F.	Danger.	Fire.
0	52					110			
	52					110			
	53				7	110	6·0		
	54					(43·4° C.)	(3·3° C.)		
	55					111			
	57					112			
1	59	7·0	Detector			113			
	(15·0° C.)	(3·9° C.)	*a*			113			
	61					114			
	63				8	115	5·0		
	65					(46·0° C.)	(2·8° C.)		
	66					115			
	69					116			
2	71	12·0				117			
	(21·2° C.)	(6·7° C.)				117			
	74					118			
	76				9	119	4·0		
	78					(48·5° C.)	(2·2° C.)		
	80					119			
	82					120			
3	83	12·0	Detector			120			
	(28·1° C.)	(6·7° C.)	*b*			120			
	86					121			
	87				10	121	2·0		
	89					(49·4° C.)	(1·1° C.)		
	90					119			
	91					121			
4	92	9·0		Detector		121			
	(33·4° C.	(5·0° C.)		*a*		121			
	94					122			
	96				11	123	2·0		
	97					(50·3° C.)	(1·1° C.)		
	98					123			
	99					123			
5	100	8·0				123			
	(39·0° C.)	(4·4° C.)				123			
	101					123			
	102				12	122	0·0		Detector
	103					(50·0° C.)			*c*
	105					123			
	106					123			
6	106	6·0	Detector			124			
	(41·0° C.)	(3·3° C.)	*c*			124			
	107				13	124	2·0		Detector
	108					(51·1° C.)	(1·1° C.)		*b*
	109								

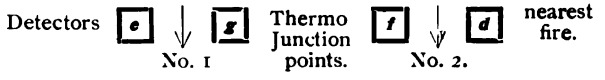
Note.—According to the testor the "Danger calls" were given by differential parts of ***a*** and ***b***, and "Fire-call" by "differential" part of ***a***. "Danger call" from ***c*** and "Fire-calls" from ***b*** and ***c*** were given by the "fixed" part of these detectors.

TEST B[1].—Four Detectors ***d***, ***e***, ***f***, ***g***, in Hut No. 2. The Indicator, Bells, and Battery were in small Committee-room.

Temperature of Hut at commencement 50° F. (10° C.). Fire started by igniting waste paper in a basket with a match at 2.48 p.m., on February 22nd, 1905.

Temperature taken by Roberts-Austen pyrometers from

points Nos. 1 and 2 placed between Detector ***d*–*f***, and ***e*–*g***, as indicated on sketch.



Detectors ***d***, ***e***, and ***f*** had "differential" parts only (***d***, "quick"; ***e***, "medium"; ***f***, "slow"), ***g*** "fixed" part only, arranged to give danger signal at 130° F. (54·4° C.), and fire signal at 150° F. (65·5 C.).

TIME AND TEMPERATURES AT WHICH THE SEVERAL DETECTORS GAVE SIGNALS IN TEST B¹.

Seconds and Minutes elapsed after Starting Fire.	Temperature recorded from Thermo-Junction. Points ° F. No. 1.	No. 2.	Seconds elapsed when the different Detectors gave Signals.	Seconds and Minutes elapsed after Starting Fire.	Temperature recorded from Thermo-Junction. Points ° F. No. 1.	No. 2.	
m. s.				m. s.			
0 00	50 (10° C.)	50 (10° C.)		3.10	112	116	
				3.20	113	116	
0.10	60	62		3.30	114	118	
0.20	68	70		3.40	115	119	
0.30	70	80		3.50	113	114	
0.40	78	85	Fire commenced	4.0	114 (45.5°C.)	115 (46.1°C.)	
0.50	80	90	burning freely.				
1 0	85	98		4.10	114	114	The damage caused by the fire was:— Table cloth burnt all round where over hanging table, waste-paper basket and contents destroyed, cane seat of one chair burnt out, and of another damaged, one leg of table scorched, newspaper on table partly burnt.
1.10	90	100		4.20	110	111	
1.20	99 (37.2°C.)	105 (40.5°C.)	80 secs. ***d*** gave danger signal.	4.50	110	110	
				5.0	108	108	
1 30	101 (38.3°C.)	111 (43.9°C.)	90 secs. ***e*** gave danger signal.	5.10	104	104	
1 40	105 (40.5°C.)	110 (43.3°C.)	105 secs. ***f*** gave danger signal.				
1.50	105	111		Fire extinguished with half a bucket of water and hand pump.			
2.0	108 (42.2°C.)	112 (44.4°C.)	120 secs. ***d*** gave fire signal.				
2.10	110	114					
2.20	110	113					
2.30	110	114					
2.40	111	113					
2.50	111	114					
3.0	110 (43.3°C.)	115 (46.1°C.)					

Note.—Detector ***g*** gave no signal, the temperature for which it was set not being reached. Detectors ***e*** and ***f*** gave no "fire signals," the rate of increase of temperature not sufficient. Under similar conditions detector ***d*** gave a "fire signal."

TEST B², February 22nd, 3.26 p.m.—Detectors, Indicators, Bells and Battery as in Test B¹.

Temperature of Hut, 79° F. (26·1° C.).

Mineral oil lamp on table lighted and fire started by

igniting waste paper in basket with a match. Lamp was extinguished by smoke from the burning paper.

Temperatures taken as in former Test B^1.

TIME AND TEMPERATURES AT WHICH THE SEVERAL DETECTORS GAVE SIGNALS IN TEST B^2.

Seconds and Minutes elapsed after Starting Fire.	Temperatures recorded from Thermo-Junction Points ° F.		Seconds elapsed when the different Detectors gave Signals.
	No. 1.	No. 2.	
m. s.			
0.0	78	80	
0 10	82	90	
0.20	90	98	
0.30	100	110	
0.40	104	120	
0.50	110	120	
1.00	110 (43·3°C.)	120 (48·8°C.)	70 secs. ***d*** gave danger signal.
1.10	115	130	73 secs. ***e*** gave danger signal.
1.20	120	132	85 secs. ***f*** gave danger signal.
1.30	124	135	92 secs. ***d*** gave fire signal.
1.40	126	135	
1.50	128	135	
2.00	130 (54·4°C.)	138 (58·8°C.)	120 secs. ***e*** gave fire signal.
2.10	132	140	130 secs. ***f*** gave fire signal.
2.20	134	142	
2.30	135	148	***g*** gave danger signal in 155 secs.
2.40	140	150	
2.50	144	154	
3.00	150 (65·5°C.)	153 (67·2°C.)	
3.10	150	160	
3.20	150	160	
3.30	157	170	
3.40	158	160	
3.50	154	162	
4.00	153 (67·2°C.)	158 (70·0°C.)	
4.10	153	160	
4.20	140	140	Detector ***g*** did not give fire signal. Highest temperature recorded close to this Detector 158° F. (70° C.).
4.30	135 (57·2°C.) Fire trampled out. No water used.	135 (57·2°C.)	

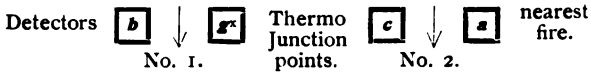
The damage after fire was—tablecloth burnt all round where overhanging top of table, lamp shade, lamp extinguished but otherwise undamaged. Top and one leg of table scorched. Chair scorched. Boxes and contents on table burnt. Waste-paper basket and contents destroyed.

TEST B³. February 22nd, 4.51 p.m.— Three double "differential" detectors ***a, b, c,*** having both "differential" and "fixed" parts, previously used in Tests A^1, A^2, A^3, were again used in this test, each fixed part intended to operate at 95° F. (35° C.) for danger, and at 112° F. (44·4° C.) for fire. A single "fixed" Detector g^x, having fixed part only, similar to the fixed parts of ***a, b, c,*** but set to give a danger call at 130° F. (54·4° C.), and a fire-call at about 150° F. (65·5° C.), was also used in this test.

Temperature of Hut 60° F. (15·5° C.).

Fire started by breaking a burning mineral oil-lamp, but the fire had to be accelerated by lighting the waste-paper basket, as the burning wick of lamp did not ignite its surroundings.

Temperatures taken by Roberts-Austen pyrometers from points Nos. 1 and 2, placed between detectors ***b*–*g*[x]** and ***c*–*a*,** as indicated on sketch—



TIME AND TEMPERATURES AT WHICH THE SEVERAL DETECTORS GAVE SIGNALS IN TEST B3.

Seconds and Minutes elapsed after starting Fire.	Temperature recorded from Thermo-Junction Points ° F.		Seconds elapsed when the different Detectors gave Signals.	Seconds and Minutes elapsed after starting Fire	Temperature recorded from Thermo-Junction Points ° F.		Seconds elapsed when the different Detectors gave Signals.
	No. 1.	No. 2.			No. 1.	No. 1.	
m.s.				m.s.			
0.0	60	60		2.20	151	151	
0.10	65	65					140 secs. ***g*[x]** gave fire signal.
0.20	75	80		2.30	154	165	
0.30	90	90		2.40	156	157	
0.40	100	101		2.50	159	100	
0.50	105	108		3.00	156	157	
1.00	109	118			(68·8°C.	(69·4°C.)	
	(42·7°C.)	(47·7°C.)		3.10	159	160	
1.10	116	124		3.20	159	160	
1.20	121	125	80 secs. ***c*** gave danger signal.	3.30	156	156	
				3.40	154	157	Damage caused by the fire :—
			86 secs. ***b*** gave danger signal.	3.50	155	156	
1.30	129	130	93 secs. ***a*** gave danger signal.	4.00	151	153	Tablecloth nearly all burnt. Contents of boxes burnt. One cane-bottom chair burnt out. Table charred generally. Waste-paper basket and contents destroyed.
					(66·1°C.)	(67·2°C.)	
				4.10	151	151	
1.40	135	139	100 secs. ***g*[x]** gave danger signal.	4.20	148	148	
				4.30	147	147	
			100 secs. ***c*** gave fire signal.	4.30	147	147	
1.50	141	141					
2.00	148	147	120 secs. ***a*** gave fire signal.	Fire extinguished with half a bucket of water and hand pump.			
	(64·4°C.)	(63·6°C.)					
2.10	150	151	130 secs. ***b*** gave fire signal.				

TEST C, February 22nd and March 8th.—Tests were made on the detectors ***h, j, k, l,*** with their conductors, indicators, and batteries in the Committee-room on ground floor.

A fall of current in the circuit from the battery cells was made by inserting resistance : this caused the battery signal

to drop, and on the resistance being increased all the danger signals dropped.

The primary closed circuit was connected to earth, with a small leakage only causing the earth signal to drop.

March 8th.—A short circuit was made in the primary conductors by connecting the positive and negative leads, this slowly exhausted the battery, and in forty minutes the battery signal dropped.

OBSERVATIONS AFTER THE TESTS.

The calls on signals continued in each case until the armatures of the different relays were replaced by the attendant.

NOTE.—The time required to exhaust the batteries by a short circuit in the conductors sufficiently to operate the battery call, depends on their condition at the time the "short" may occur.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and conducted by a Sub-Committee of the Executive, comprising :—

Mr. James Sheppard, A.Inst. E.E., North British and Mercantile Insurance Co. (Directing Member).
Mr. J. W. Restler, M.Inst.C.E. (Metropolitan Water Board)
Mr. E. de Segundo, M.I.Mech.E.

Mr. A. H. Lister assisted the Sub-Committee.
Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Executive was represented by :—

Mr. Edwin O. Sachs, F.R.S.Ed. (Chairman).
Mr. Ellis Marsland, District Surveyor, Camberwell (Gen. Honorary Secretary).

The General Body of Members was represented on February 22nd by :—Messrs. E. R. Hewitt (District Surveyor, Southwark and North Lambeth); Walter M. Hitchcock (Geelong Fire Brigade); Major Huleatt, R.E. (Home District), and Capt. J H. Thompson (H.M. Chief Inspector of Explosives, Home Office).

The Autopyrophone Co. were represented by ;—Messrs. M. A. Abrahamson; Emil Henius; Wm. de Jongh; and H. E. Tvermoes.

The following visitors attended on February 22nd by special invitation of the Executive :—His Excellency the Danish Minister (Mr. de Bille), the Danish Secretary of Legation; the Danish Consul: further, Messrs. Wm. Griffith; C. Gottlib; Divisional Officer S. Gamble, F.S.I. (London Fire Brigade); Charles E. Herbert; Frantz Morthensen; Frank W. Macey; Herb. Müller; John T. Osler; C. E. Pothecary; Supt. Geo. Stubbings (G. E. Railway Fire Brigade); a representative of the Architects Department, L.C.C.; and Hugo Slöör (Stockholm).

Signed.

For the Sub-Committee conducting the Test :

JAMES SHEPPARD (*Directing Member*).

For the Executive :

ELLIS MARSLAND (*Gen. Hon. Secretary*).

Published by the Committee as directed by the Executive.

CHARLES ADAMI (*Assist. Secretary.*)

Date—April 29th, 1905.

Verified a true Copy of the Report, ordered to be published,

ROSE-INNES, SON & CRICK (*Solicitors*).

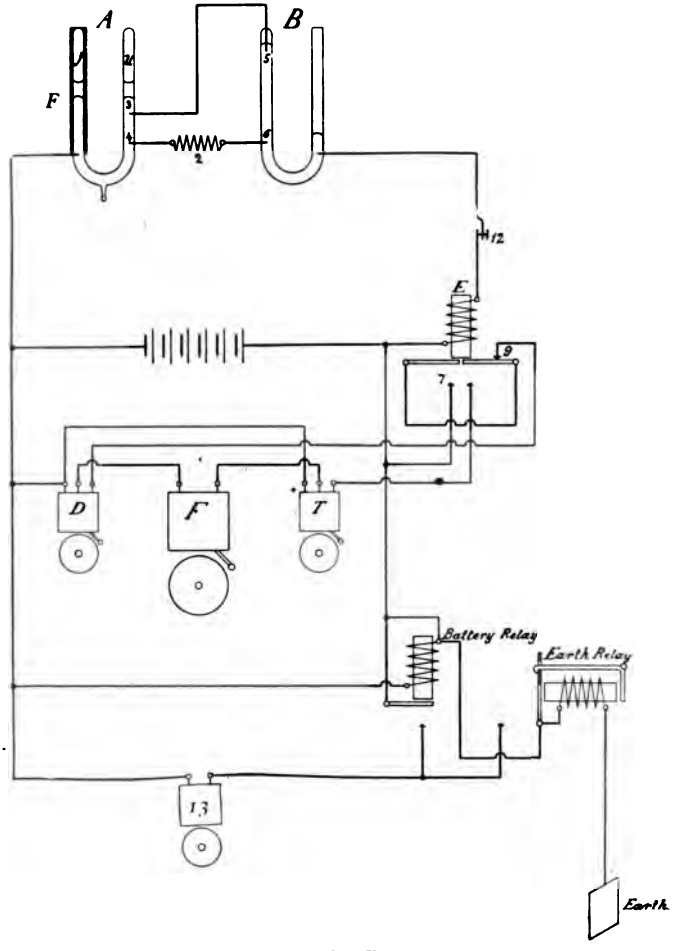
Date—May 1st, 1905.

APPENDIX.

THE MANUFACTURER'S DESCRIPTION OF THE AUTOPYROPHONE SYSTEM.

The different parts of this fire detector system are :

The Detectors, the Fire Switches, the Primary Circuit, the Indicator Board, the various Calls, the Secondary Circuit, the Battery.



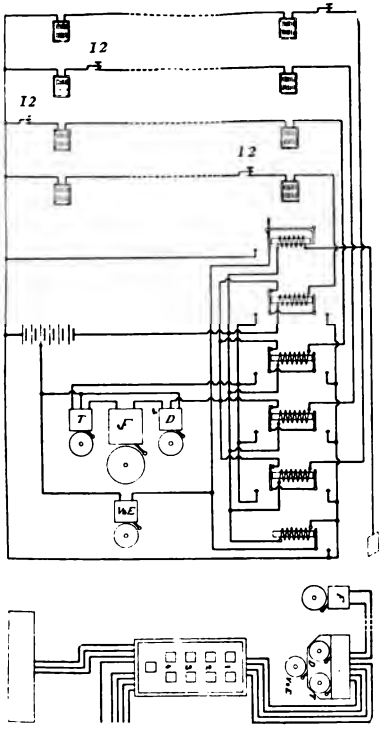
Appendix Fig. 1.
(THE SYSTEM FOR ONE DETECTOR.)

Fig. 1 shows diagrammatically all connections in the system for one detector, the necessary relays, calls, etc.

Fig. 2 the same for four groups of any number of detectors.

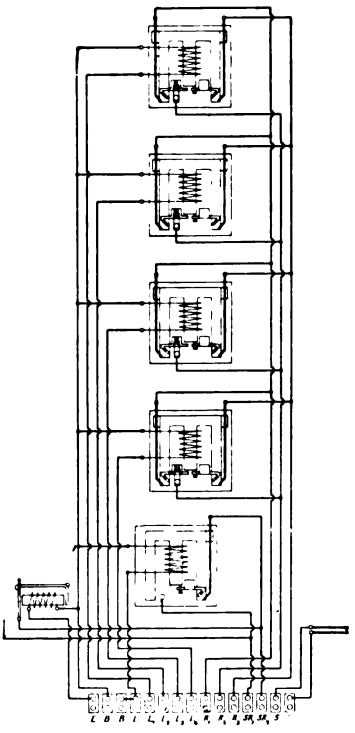
The Detector consists of (*see* Fig. 1) :

1.—A differential thermometer *A* where the one branch *f* is retarded by means of an insulating sleeve *F*. A's action therefore depends on the rate of increase of temperature.



Appendix Fig. 2.

(THE SYSTEM FOR 4 GROUPS OF ANY NUMBER OF DETECTORS.)



Appendix Fig. 4.

(THE ARRANGEMENT OF THE INDICATOR BOARD.)

2.—A fixed temperature thermometer *B*, that practically remains stationary until a certain temperature has been reached, and then has a long range for small increases of temperature.

3.—A resistance *2* connected to points *4* and *6* in *A* and *B*.

4.—A connecting wire of low resistance between points *3* and *5* in *A* and *B*.

The detector is mounted, as shown in Fig. 3 half full-size, on a porcelain base *C* and protected by a brass fender *D*. The resistance

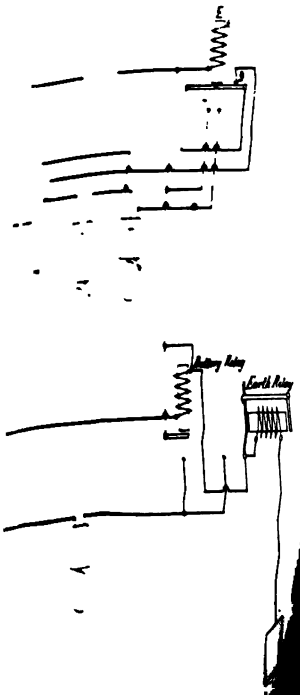
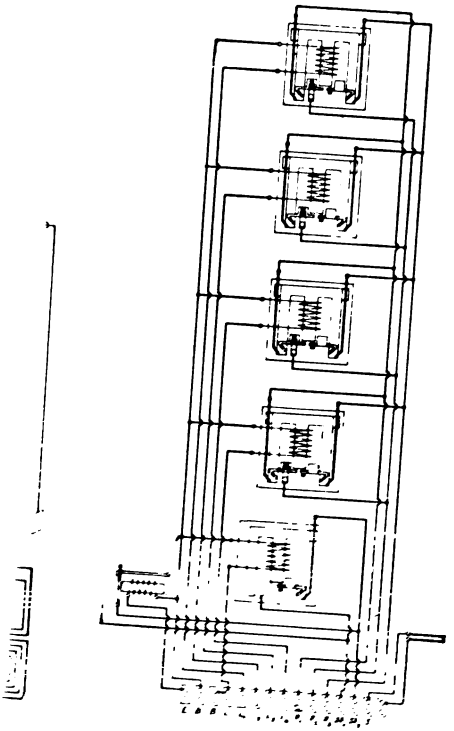


Fig. 1.

of any number of detectors.

A where the one branch *f* is retarded
sieve *F*. A's action therefore depends
perature.



Appendix Fig. 4.

(THE ARRANGEMENT OF THE INDICATOR BOARD.)

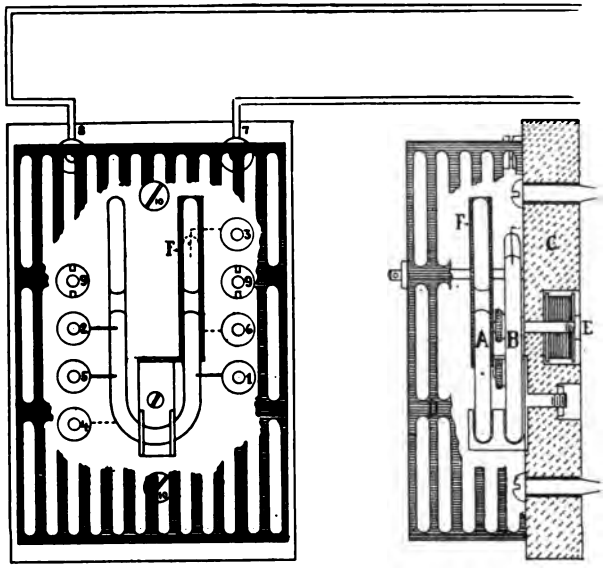
rmometer *B*. that practically remains
perature has been reached. and then has
ses of temperature.
points *4* and *6* in *A* and *B*.
resistance between points *3* and *5* in *A*

as shown in Fig. 3 half full-size. on a

is embedded in the base at *E* and amply protected against injury. The binding screws *7* and *8* are for the connection to the detector.

The Fire Switches are in the normal condition closed and sealed in such a manner that they cannot be used without this being evident. They are marked *12* on Figs. *1* and *2*.

The Primary Circuit consists of wires with a good solid rubber covering, run in plain sight and supported on cleats, so that the insulating cover of the conductors can only come in contact with the supports, protecting bushings and the connecting instruments.



Appendix Fig. 3.

THE DETECTOR.

The Indicator Board has one relay for each group of Detectors, one battery relay and one relay for earth leakage. *Fig. 4* shows diagrammatically all the internal connections.

The Various Calls: Fig. 5 shows the connections for the various calls, with connecting pieces FF for wires to the Fire Call.

The Secondary Circuit consists of wires with a solid rubber cover *throughout*, enclosed in steel tubing.

The Battery consists of the necessary number of dry cells, except for large plants where a secondary battery is used.

The system used is a closed circuit system and in normal conditions (see *Fig. 1*) the current through the Detector has two paths, one from 3 to 5, the other from 4 to 6.

When a smouldering fire starts, causing a low rate of increase of temperature B will break the one path of the circuit at 5, when the temperature reaches a certain height. On the temperature increasing further about 15° F. the other path will be broken at 6.

If instead of a smouldering fire there is a sudden fire, causing a big rate of increase of temperature, the same result will be obtained, but the circuit will be broken first at 3 and afterwards at 4. When the circuit is broken either at 3 or 5, the Armature 7 will drop, thus starting the danger call D ; when the circuit afterwards is broken at 4 or 6 the Armature (9) will drop, breaking the circuit through the danger-call and starting the trouble-call T.

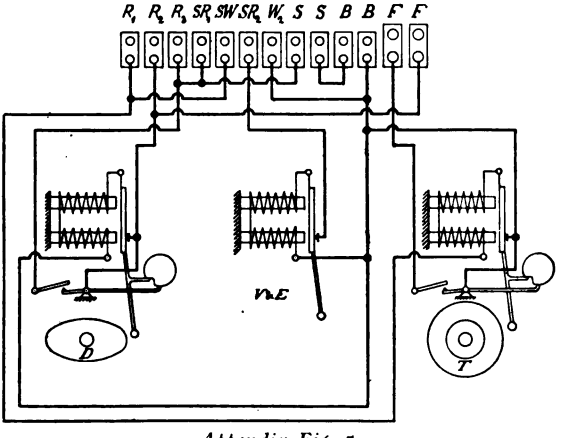
Both the danger- and trouble-call operate each a switch on the fire-call circuit. These switches are in series so that the fire-call F will only be switched on when both switches have been operated.

In above case the fire-call would therefore start as soon as the trouble-call had started.

In case the circuit had been broken by means of the fire switch (12) after the one path was broken at 3 or 5, this will do the same as breaking the circuit afterwards at 4 or 6.

If a break occurs on the Primary Circuit, both Armatures 7 and 9 will drop, thus starting the trouble-call T only. The battery and earth-call (13) is started when either the battery voltage drops to a certain point, or if there is any earth leakage on the system.

In case a fire-call is wished for at once, instead of first a danger-call and then a fire-call, this is done by keeping the switch on the trouble-call permanently closed.



Appendix Fig. 5.

CONNECTIONS FOR VARIOUS CALLS.

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THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897—Incorporated 1899),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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ELLIS MARSLAND, District Surveyor.

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WATERLOO PLACE, PALL MALL, LONDON S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 10. CASEMENT NO. 2, AFTER THE TEST (FROM THE FIRE SIDE).

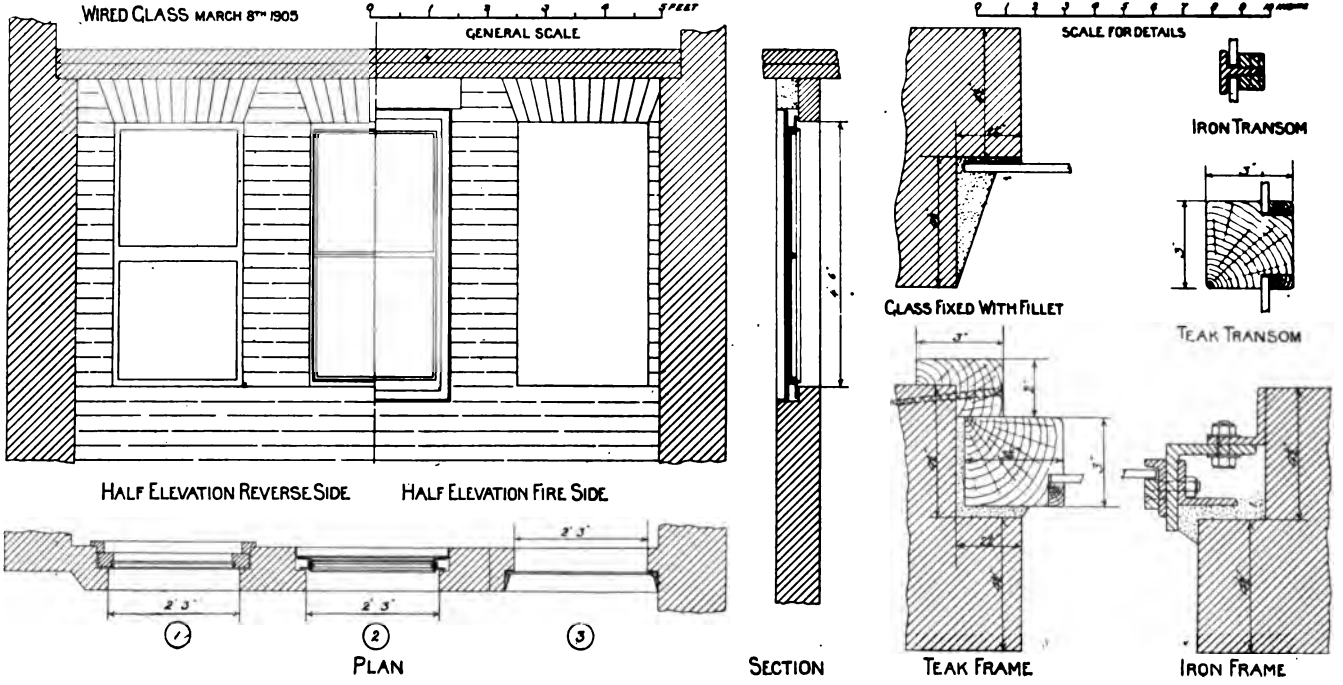
NOTE.

In these days, when all sorts of appliances for the prevention of fire are advocated, it is of importance to consider at the same time the means to be adopted and the materials to be used to prevent the *spread* of fire. Many of these materials are expensive, and in some cases little is known of their behaviour under actual fire conditions. The comparatively moderate cost of wired glass has led to the present investigation in the hope that the knowledge gained thereby will be useful to all interested in the subject of Fire Prevention.

SOTHERAN

MAX CLARKE.

London,
July 20th, 1905.



Figs. 5 *and* 6. DETAILS OF CASEMENTS.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST No. 63—MARCH 8TH, 1905.

THREE VERTICAL OPENINGS

FILLED IN WITH

WIRED GLASS

BY

MESSRS. PILKINGTON BROS., LTD.,

ST. HELENS AND LONDON.

OBJECT OF TEST.

To record the effect of a fire of three-quarters of an hour's duration. The temperature to reach 1,500° Fahr. (815·5° *C.*), but not to exceed 1,650° Fahr. (898·8° *C.*), followed by the application of water for two minutes, with the view of being classified as affording temporary protection (Class A).

Note.—The squares of glass, five in number, were to be glazed, two into a teak frame, two into a steel frame, and one into brick reveals.

Each opening was approximately 2 ft. 3 in. (0·685 *m.*) wide by 4 ft. 6 in. (1·37 *m.*) high.

The openings are described as Nos. 1, 2, and 3:

No. 1 being a teak frame, fixed in the north opening.

No. 2 being a steel frame, fixed in the centre opening.

No. 3 being a square of glass, in brick reveals.

SUMMARY OF TEST.

Immediately on lighting the gas the glass in all the openings cracked, particularly round the edges. Beyond the cracks increasing, no perceptible change occurred.

The inside face of the teak framed architrave was considerably charred.

On the application of water there was an irregular patch of small holes made in the upper portion of the centre light, which was also bulged inwards; but otherwise the glass in all the openings remained in position. There were indications that the fire had passed between the frame and the glass of opening No. 1.

The fire did not pass through the glass.

DESCRIPTION OF THE TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The Testing Chamber was located at the Committee's Testing Station, being Hut No. 1.

The chamber was constructed as shown of stock work in lime mortar, and measured internally 10 ft. (3·048 *m.*) by 10 ft. (3·048 *m.*).

The ceiling of the hut was 8 ft. 11 in. (2·72 *m.*), above the pavement of the chamber.

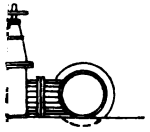
The ceiling or roof of the chamber was constructed of wood beams, placed close together to make a solid top; the joints being grouted in with fire clay and the top covered with brick rubbish.

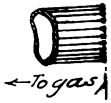
The chamber was divided by a 9 in. (0·229 *m.*) wall of brickwork, with two compartments, measuring 3 ft. 8 in. (1·12 *m.*), and 5 ft. 7 in. (1·7 *m.*), respectively by 10 ft. (3·048 *m.*).

The three openings for the glass were formed in this wall.

There were door openings into the large compartment on the west and south sides, and an observation hole on the north side, the latter protected by a sheet-iron cover.

The fuel used was gas produced at the station, the supply being regulated by valves and dampers.




←To gas

The gas was admitted through a mixing chamber of fire brick into the northern compartment 10 ft. (3·048 *m.*), by 3 ft. (0·914 *m.*), indicated on Figs. 1 to 3.

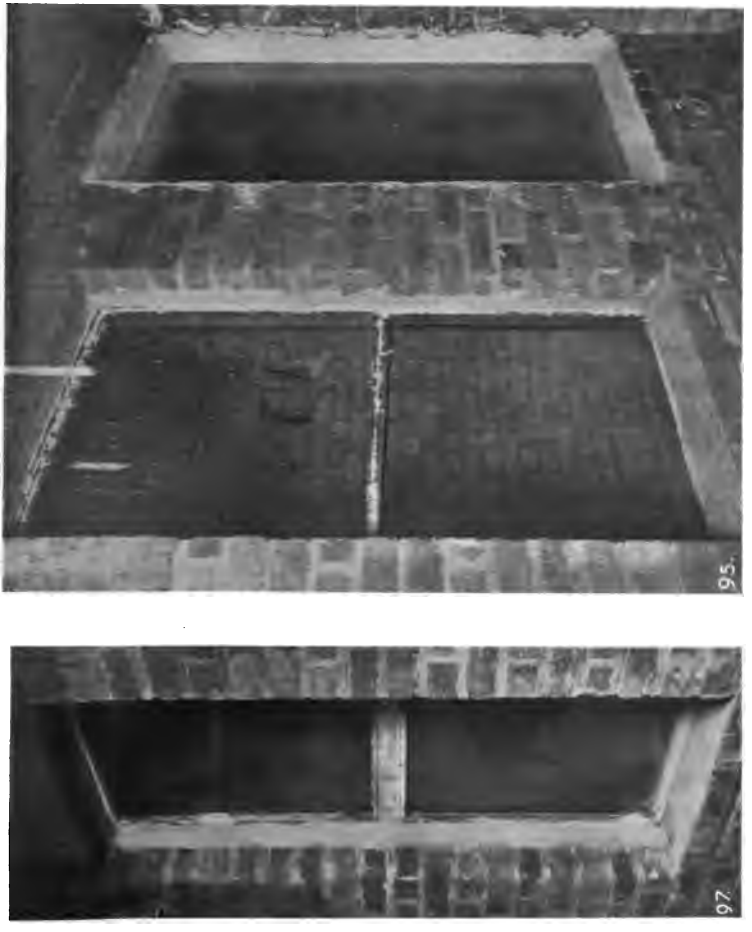


Fig. 7. The Three Openings (from Outside) before the Test.

Two Roberts-Austen pyrometers were used for recording temperatures, the instruments being used for the observation records at Points Nos. 1, 2, and 4, and for continuous

record at Point 3. Points Nos. 2, 3, and 4, being in the chamber and Point No. 1a in the passage.

There were ventilation holes in the upper portion of both the northern and southern walls.

The photographs were taken partly by daylight and partly by flashlight.

The stream of water was applied through a hose and branch with ¾ in. (·019 *m.*) nozzle, and supplied from a small steam fire engine equipped with a pressure gauge.

CONSTRUCTION OF THE CASEMENTS AND GLAZING.

(*See Figs.* 1 *to* 7.)

The fixing of the frames and glass in the reveals of the 9-in. wall (·229 *m.*) was completed on March 7th, 1905.

The frame in No. 1 opening was made of teak, as shown by drawing *Figs.* 5, 6. The frame was 3 in. by 3¼ in. (·076 *m.* by ·082 *m.*). The frame was fixed on the inner or fire side of the wall. The joint between the woodwork and the brickwork being covered by a rebated teak architrave, screwed to a concrete fixing brick built into the wall. The glass was patent wired rough-cast, ¼ in. thick (·0063 *m.*).

The iron frame in No. 2 opening was constructed of T and L iron, as shown on the detail, *Figs.* 5, 6. The glass in this opening was polished plate wired glass, the same thickness as that above described. This frame was also fixed on the inner or fire side of the wall.

The glass in opening No. 3 was fixed into the brickwork without any frame, it being bedded in a composition of plaster. The detail of the fixing is shown, *Figs.* 5, 6.

THE TEST.

On March 8th, 1905, the test was undertaken. The following is a log of the test :—

At 3 p.m. the meteorological observations at the Botanic Gardens, Regent's Park, read as follows :—

State of weather, cloudy; wind, S.S.E.; barometer, 29·99 in.; wet bulb, 43° Fahr.; dry bulb, 47·0° Fahr (3·8 *C.*).
Remarks: Fine afternoon.

Observations.	Minutes elapsed.
2.29 p.m. The gas was lighted and the test commenced. Immediately after, all the squares of glass cracked more or less, particularly round the outer edges. One long vertical crack in No. 1 square.	
2.33 p.m. Smoke coming through the joint between frame and brickwork of Frame No. 1.	4
2.55 p.m. Frame of No. 1 burning all round on inside.	26
3.3 p.m. Glass of No. 1 darkened all over inside with smoke. Cracks in all squares increasing, but No. 2 least cracked. Sill of frame of No. 1 burning very fiercely inside.	34
3.15 p.m. Gas was turned off.	46
3.18 p.m. Water was turned on, with a pressure of about 45 lb. per square inch (3·06 *atms.*) striking the glass on the side away from the fire.	49
3.20 p.m. Water was turned off. Where the water struck the upper portion of No. 2 there was an irregular patch of small holes made, but otherwise the glass in all the openings remained in position.	51

Note.—The pyrometer point in the passage during the test did not attain 100° Fahr. (37·7 *C.*).

TEMPERATURES.

The temperatures, read from observation records off pyrometer points Nos. 1, 2, and 4, were as follows:—

Time.	Inside.			Outside (in Passage).	Minutes Elapsed.
	No. 2.	No. 4.	No. 3.*	No. 1.†	
	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	
2.30	800	800	—	—	—
2.35	750	650	—	—	5
2.40	650	650	—	—	10
2.45	1210	1180	—	—	15
	(654·4)	(637·7)			
2.50	1200	1100	—	—	20
2.55	1210	1100	—	—	25
3.00	1250	1200	—	—	30
	(676·6)	(648·8)			
3.5	1250	1150	—	—	35
3.10	1200	1300	—	—	40
3.13	1300	1450	1500*	—	43
3.15	1350	1400	—	—	45
	(732·2)	(760·0)	(815·5)		

Degrees in italics are Centigrade.

* This temperature was shown on the continuous record.

† Readings off this Point com nence only at 100° Fahr. (37·7° C.).

OBSERVATIONS AFTER TEST.

March 11th, 1905. (*See Figs.* 8, 9, 10.)

Opening No. 1:—

Glass cracked and starred all over.

Evidence of fire having come through along the top of upper square and about 6 in. (·152 *m.*) down each side.

Inside the wood frame was charred to an average depth of $\frac{5}{8}$ in. (·016 *m.*). The upper part of the architrave was gone and the upper part of the frame was burned right through to the brick reveal.

Opening No. 2:—

Glass cracked and starred all over, as shown on *Figs.* 8, 9, 10. The upper square perforated and bulged inwards $1\frac{1}{4}$ in. (·044 *m.*), the pointing outside down right side (east) of frame defective, the outside stopping to glass in the frame loose, but frame uninjured.

Opening No. 3:—

Glass starred and cracked, fixing uninjured

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and conducted by a Sub-Committee of the Executive comprising :—

Mr. Max Clarke, F.R.I.B.A., *Directing Member.*
Mr. Ellis H. Pritchett, F.R.I.B.A., F.S.I. (Chief Officer, Swindon Fire Brigade) [the late].
Mr. Oswald C. Wylson, F.R.I.B.A.
Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham).

Mr. A. H. Lister assisted the Sub-Committee.
Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Council was represented by—
Mr. H. H. Collins, F.R.I.B.A. (District Surveyor, Eastern Division City of London).

The Executive was represented by—
Mr. Edwin O. Sachs, F.R.S.Ed. (Chairman).
Mr. James Sheppard, A.Inst.E.E. (Surveyor, North British and Mercantile Insurance Company).
Mr. Ellis Marsland (District Surveyor, Camberwell).
Mr. J. H. Dyer (Vice-President, Nat. Fire Brigade Union).

The general body of members was represented by—
Lieut.-Col. George W. Dixon, V.D. (Vice-Pres. Nat. Fire Brigade Union) [the late] ; Messrs. Ej. J. Fulkes (Royal Insurance Company) ; Matt. Garbutt, A.R.I.B.A. (Surveyor, Met. Ry. Co.) ; F. W. Hamilton, A.R.I.B.A. District Surveyor, Nth. Fulham; R. P. Notley, F.R.I.B.A. (District Surveyor, Bethnal Green) ; F. B. Passmore ; and J. J. Thomas (Chief Officer Liverpool Fire Brigade).

Messrs. Pilkington Bros., Ltd., were represented by—
Mr. A. C. Pilkington ; Mr. D. W. Ames ; Mr. F. E. Chambers ; and Mr. A. W. Dutton.

No. 1. *No* 2.

Fig. 8. CASEMENTS NOS. 1 AND 2 AFTER THE TEST (FROM OUTSIDE).

No. 2. *No.* 3.

Fig. 9. CASEMENTS NOS. 2 AND 3 AFTER THE TEST (FROM OUTSIDE)

The following visitors attended at the Testing Station by special invitation of the Executive during the Testing operations of March 8th. :—

Messrs. The Danish Consul-General (J. Faber); J. Gavey, M.Inst.C.E., C.B., Engineer-in-Chief, W. Brown and W. Alex. Moir, of the General Post Office; Chief Officer Captain Hamilton, R.N.; Divisional Officer Sidney Gamble, F.S.I., and Divisional Officer Lieut. Sladen, R.N., of the London Fire Brigade; A. C. Booth; C. H. J. Cooper; H. F. Dale; H. K. Dyson; H. A. McFarren (Asst. Eng., H.M. Office of Works); E. Henius; Arthur B. Hayward; Wm. de Jongh; — Jackson; J. Lassen; N. G. Pennington; J. Pulleine; J. Redgrave, (H.M. Superintending Inspector of Factories, Home Office); W. A. Rees (Liv., Lond. and Globe Insurance Co.); H. Rallings; George Stubbings, Supt. of Fire Brigade, Great Eastern Railway; J. W. Ward; Hugh P. Whall; and R. Young.

(Signed) *For the Sub-Committee conducting the Test :*
MAX CLARKE, *Directing Member.*

For the General Testing Arrangements Sub-Committee :
ELLIS MARSLAND.

For the Executive :
JAMES SHEPPARD.

Published by the Committee as directed by the Executive.
C. ADAMI.

Date—August 12th, 1905.

Verified a true copy of the Report ordered to be published.
ROSE-INNES, SON AND CRICK.

Date, August 18th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal etc., are obtainable upon application to the Assistant Secretary 1, Waterloo Place, Pall Mall, London, S.W.

SOUTHWOOD, SMITH & CO., LTD., LONDON, E.C.

"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 96.

Edited by the Executive.

FIRE TESTS WITH FLOORS.

A FLOOR

BY

THE NATIONAL FIREPROOFING COMPANY,

PITTSBURG, U.S.A.; AND LONDON.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

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E. de SEGUNDO, A.M.Inst.C.E.; OSWALD C. WYLSON, F.R.I.B.A.;
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(CHARLES ADAMI, *Assistant Secretary.*)

THE GENERAL ARRANGEMENTS FOR TESTS

(*MEMORANDUM.*)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

NOTE.

This test is of unusual interest, as it is the first test made by the Committee with a fire-resisting floor constructed of "semi-porous" terra-cotta blocks with steel wire reinforcement.

ELLIS MARSLAND.

July 20th, 1905.

SOTHERAN

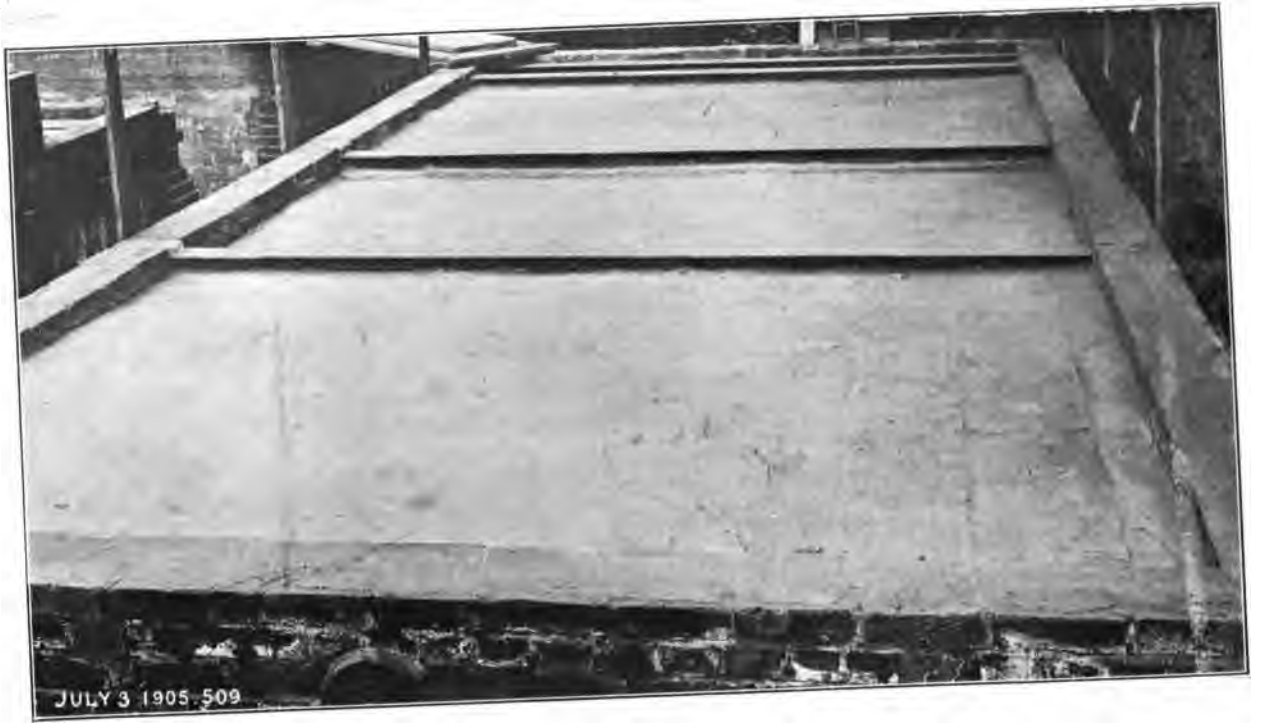


Fig. 9. THE FLOOR. VIEW AFTER TEST (AFTER LOAD REMOVED).

OFFICIAL REPORTS

OF THE

sh Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST No. 69.—JUNE 28TH, 1905.

A FLOOR

BY

HE NATIONAL FIREPROOFING COMPANY

PITTSBURG, U.S.A.; AND LONDON.

OBJECT OF TEST.

To record the effect of a fire of four hours' duration, the mperature to reach 1800° Fahr. (982·2 *C.*), but not to ceed 2200° Fahr. (1204·4 *C.*), followed by the application water for five minutes, with a view to classification under Full Protection" (Class B).

Note.—The area of the floor under investigation was to be at ast 200 ft. sup. (18·58□*m.*). The floor was to be loaded ith 280 lb. (127 *kg.*) per foot (·3□*m.*) distributed.

The time allowed for drying was twenty-eight days summer).

SUMMARY OF EFFECT.

Small patches of plaster flaked off the soffit of the ceiling during the test.

On the application of water the plaster to the soffit of the floor where struck by the jet was washed off.

The maximum deflection of the floor during the test was $\frac{3}{8}$ in. (·0095 *m.*).

The fire did not pass through the floor.

On the removal of the load the upper surface of the floor was found intact, but for one crack at the north-west end (see Fig. 9), and there was no permanent deflection.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The testing chamber was located at the Committee's New Testing Station, and was known as "No. 2 Hut."

The chamber was constructed as shown, of stock bricks, with lime mortar, and measured 10 ft. by 22 ft. 3 in. (3·05 *m.* by 6·78 *m.*) internally.

The ceiling of the floor tested was 8 ft. 3 in. (2·51*m.*), above the pavement of the chamber.

The hut was temporarily covered with tarpaulins.

The door-openings on the north, south, and east sides measured 2 ft. by 6 ft. (·61 *m.* by 1·83 *m.*), and were closed by being filled in with brickwork, $4\frac{1}{2}$ in. (·114 *m.*) thick.

The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

The gas was admitted through four mixing chambers of fire-bricks each 10 ft. by 3 ft. (3·05 *m.* by ·91 *m.*), as shown.

Two Roberts-Austen pyrometers were used for recording temperatures, the first to take a continuous record from point 10, and the second to take observations from points 1 to 9.

The load was of bricks, distributed on the surface of the floor in four piles (see Fig. 7).

There were four observation holes in the west wall, one in the south wall, one in the north wall, and two in the east wall, the last four being formed in the bricked-up door-openings, each covered with a movable iron shutter.

The draught holes were in the west, north, and south walls.

The photographs were taken by daylight and by flashlight.

Water was applied through a branch with ¾ in. (·02 *m.*) nozzle supplied from a small steam fire engine.

CONSTRUCTION OF THE FLOOR.

(*See Figs.* 1 *to* 6.)

The construction of the floor, illustrated in Figs. 1 to 6, was as follows :—

The floor was divided into four bays of the following widths, viz., 7 ft. 7½ in. (2·32 *m.*), 6 ft. (1·83 *m.*), 7 ft. 6 in. (2·29 *m.*), and 1 ft. 1½ in. (·34 *m.*), respectively.

On the set off on the north and south wall of the hut 3½ by 9½ (·09 *m.* by ·23 *m.*) channel irons were placed weighing 25 lbs. (11·33 *kgs.*) per foot run (·30 *m.*). These were secured to the brick parapet by a short bolt through the centre and terminated on the outside of the parapet by a cast-iron washer.

Three steel joists 10 in. by 5 in. (·25 *m.* by ·13 *m.*), and weighing 30 lbs. (13·60 *kgs.*) per foot run (·30 *m.*), were placed on the set-off of the hut dividing the space to be occupied by the floor into the four bays of the widths above described.

There were three tie-rods ¾ in. (·02 *m.*) diameter to each bay, one in the centre and one at each end.

Wooden centering was fixed 1½ in. (·04 *m.*) from the bottom flanges of the steel joists.

The floor was constructed of hollow terra-cotta blocks, described as " semi-porous."

Soffit slabs of similar terra-cotta 1¼ in. (·03 *m.*) thick were placed under the bottom flanges of the steel joists and on

either side skew back blocks were fitted (see detail Fig. 5), the blocks forming the general body of the floor measured in the three outer bays 12 in. by 6 in. by 8 in. (·30 *m.* by ·15 *m.* by ·20 *m.*) in depth, and in that of the centre bay 12 in. by 6 in. by 6 in. (·30 *m* by ·15 *m.* by ·15 *m.*) in depth. The blocks forming a series of flat arches with a key block in the centre. The blocks were cemented together with Portland cement

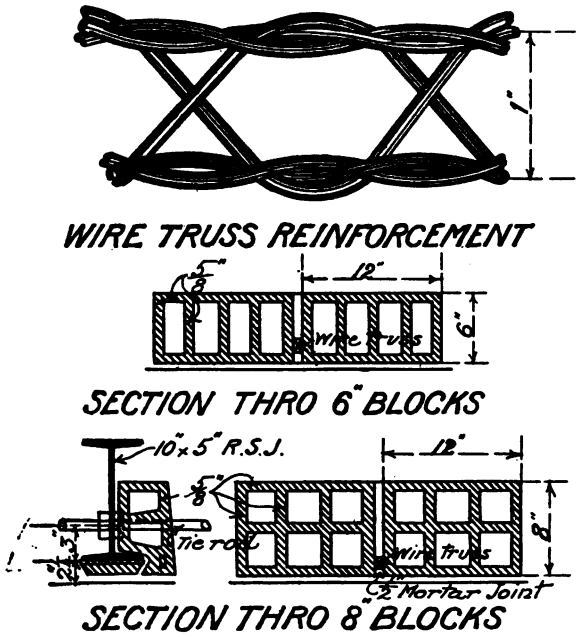


Fig. 5. DETAILS OF THE FLOOR.

and clean sharp sand in the proportion of three parts of sand to one part of cement.

In the vertical joints between each row of blocks forming the arch from joist to joist was placed a metal reinforcement, consisting of a trussed band of mild steel wire 1½ in.

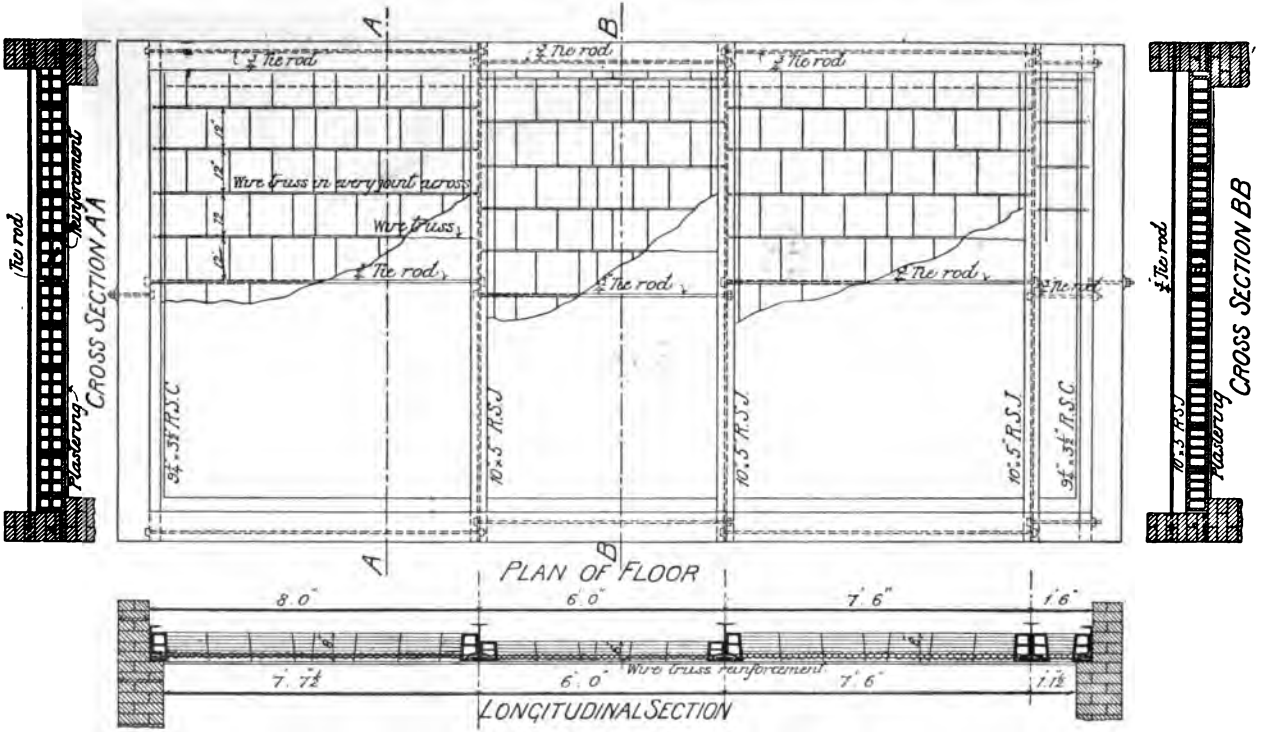


Fig. 6. THE FLOOR, PLAN AND SECTIONS.

Fig. 7. THE FLOOR, VIEW TAKEN BEFORE TEST (SHOWING LOAD).
Time 1.7 *p.m.*

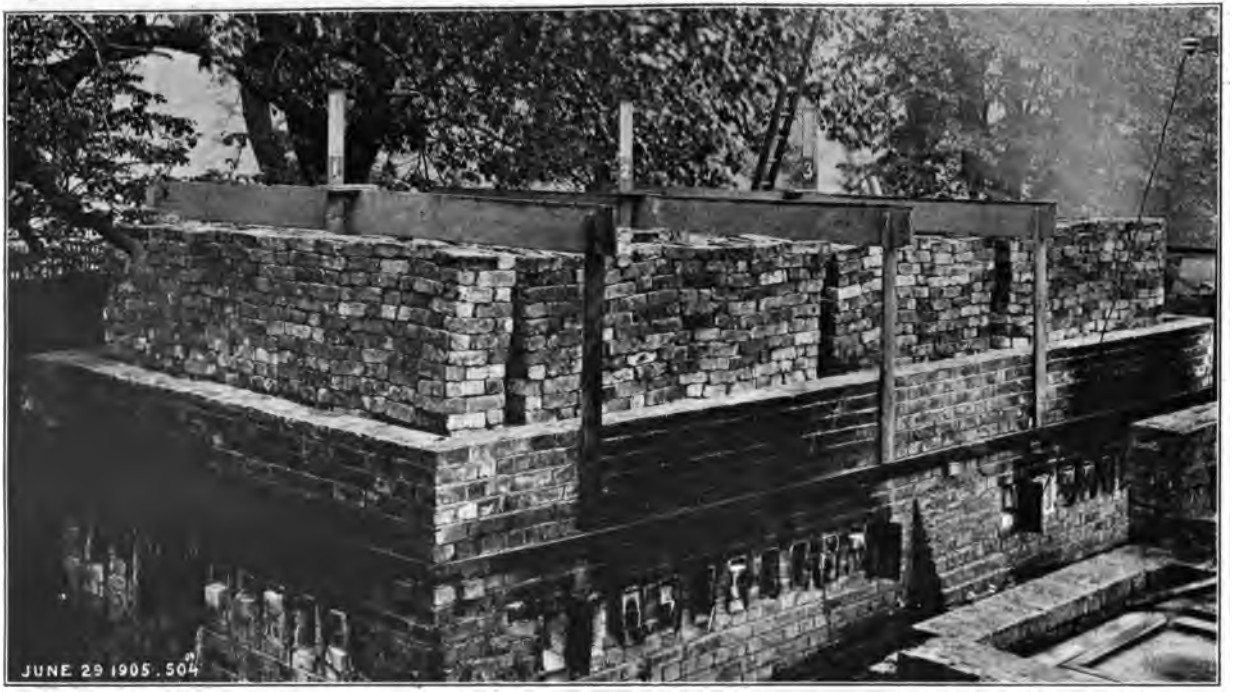


Fig. 8. THE FLOOR, VIEW AFTER TEST (SHOWING LOAD).

(·03 *m.*), deep woven and interlaced (see Figs. 5 and 6). The wire was of two thicknesses, viz., 11 and 14 gauge. The metal reinforcement was not fastened to the joists, but merely built in with the blocks about one inch from the soffit.

The top surface of the arch was rendered with the cement mortar and the soffit was plastered with "seraphite" plastering in three coats, the thickness being about 1 in. (·025 *m.*).

The dimension from the underside of the steel joist to the soffit of the plastering averaged 2¼ in. (·157 *m.*).

The fixing of the terra-cotta blocks was commenced on May 16th, and completed on May 20th. The centering was removed on May 22nd, and the plastering was commenced on May 23rd, and completed by May 28th.

PREPARATIONS FOR TEST.

During the week preceding the tests the floor was loaded with stock bricks equal to a distributed load of 280 lbs. (127 *kg.*) per square foot.

The tarpaulins were finally removed on the morning of the 28th June, before the test began.

THE TEST.

On June 28th, 1905, the test was undertaken. The following is a log of the test :—

At 3 p.m. the meteorological observations taken at the Botanic Gardens, Regent's Park, read as follows :—

"State of weather, cloudy; Wind, S.W.; Barometer, 29·77 inches; attached thermometer, 69° Fahr. (20·5 *C.*; dry Bulb, 72·5° Fahr. (22·4 *C.*); wet Bulb, 62° Fahr. (16·6 *C.*); Remarks: Fine afternoon."

The table on p. 16 shows the temperatures taken from the nine pyrometer observation points in the hut, shown on Figs. 1 to 4 as Nos. 1 to 9.

	Minutes Elapsed.
3.45 p.m. The gas was lighted.	
4.30 p.m. A small blister appeared in plaster of ceiling, about one-third from south end.	45
4.37 p.m. The plaster had flaked off in small patches in several places.	52
7.45 p.m. Ceiling was covered with haircracks.	240
7.45 p.m. The gas was shut off.	240
7.47 p.m. Water applied at a pressure of about 65 lbs. through a branch with a $\frac{3}{4}$ in. (·02 *m.*) nozzle. The effect of this was to wash away the plastering from the soffit of the floor where struck by the jet.	242
7.52 p.m. The water was turned off. The fire and water had not passed through the floor.	247

DEFLECTION OBSERVATIONS.

The deflections of the steel joists were taken by a level placed on the roof of an adjoining hut, and wooden staffs were placed on the centre of each steel joist, the readings being taken every five minutes during the test.

The deflection never at any point during the test exceeded $\frac{3}{8}$ in. (·009 *m.*).

TABLE SHOWING DEFLECTIONS OF STEEL JOISTS.

TIME.	POINT NO. 1.	POINT NO. 2.	POINT NO. 3.
p.m.	Inch.	Inch.	Inch.
3.50	0	0	0
4.10	0	0	0
5.15	0	0	0
5.45	0	$+\frac{1}{8}$ (·003 *m.*)	$+\frac{1}{8}$ (·003 *m.*)
5.50	$+\frac{1}{8}$ (·003 *m.*)	$+\frac{1}{8}$	$+\frac{1}{8}$
6.20	$+\frac{1}{8}$	0	0
6.25	0	0	0
6.50	0	$-\frac{1}{8}$	0
7.0	$-\frac{1}{8}$	$-\frac{1}{8}$	$-\frac{1}{8}$
7.5	$-\frac{1}{8}$	$-\frac{1}{8}$	$-\frac{1}{8}$
7.10	$-\frac{1}{8}$	$-\frac{3}{16}$ (·004 *m.*)	$-\frac{1}{8}$
7.20	$-\frac{1}{8}$	$-\frac{1}{4}$ (·006 *m.*)	$-\frac{1}{4}$
7.35	$-\frac{1}{8}$	$-\frac{5}{16}$ (·007 *m.*)	$-\frac{1}{4}$
7.45	$-\frac{1}{8}$	$-\frac{3}{8}$ (·009 *m.*)	$-\frac{1}{4}$

TEMPERATURES.

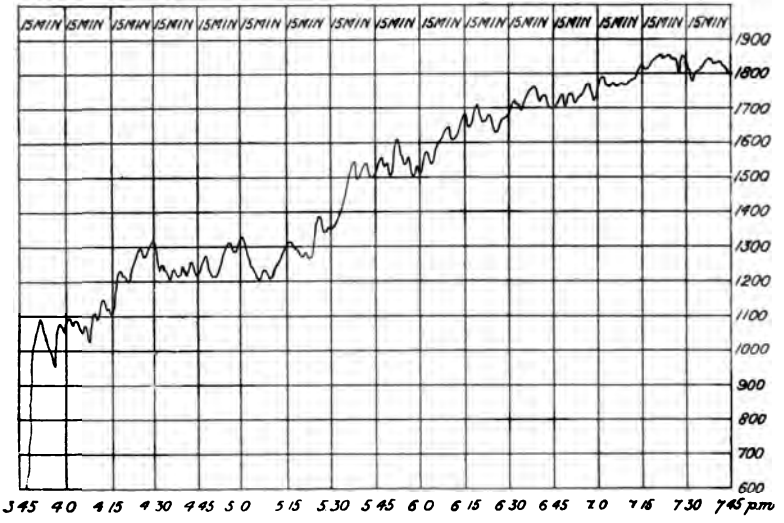
Observations taken at points Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9.

From 3.45 *p.m.* to 7.45 *p.m.*

Time.	1	2	3	4	5	6	7	8	9	Min. elapsed.
p.m.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	
3.50	700	800	750	850	950	820	820	720	700	5
3.55	730	800	800	900	920	800	780	750	800	10
4.0	720	780	790	880	940	840	850	845	790	15
	(382·2)	*(415·5)*	*(421·1)*	*(471·1)*	*(504·4)*	*(448·8)*	*(454·4)*	*(451·6)*	*(421·1)*	
4.5	820	830	840	840	950	850	850	920	830	20
4.10	900	920	900	930	1000	960	960	1005	940	25
4.15	990	980	960	980	1020	980	970	1050	980	30
	(532·2)	*(526·6)*	*(515 5)*	*(526·6)*	*(548·8)*	*(526·6)*	*(521·1)*	*(565·5)*	*(526·6)*	
4.20	1050	1060	1080	1100	1100	1080	1100	1180	1050	35
4.25	1140	1120	1120	1130	1140	1120	1140	1220	1150	40
4.30	1240	1160	1180	1180	1220	1180	1200	1300	1190	45
	(671·1)	*(626·6)*	*(637·7)*	*(637·7)*	*(660·0)*	*(637 7)*	*(648·8)*	*(704 4)*	*(643·3)*	
4.35	1200	1140	1160	1120	1140	1120	1140	1230	1180	50
4.40	1220	1180	1170	1120	1140	1130	1160	1250	1200	55
4.45	1210	1180	1170	1140	1130	1140	1170	1240	1200	60
	(654·4)	*(637·7)*	*(632·2)*	*(615·5)*	*(610·0)*	*(615·5)*	*(632·2)*	*(671·1)*	*(648·8)*	
4.50	1240	1180	1180	1150	1160	1170	1170	1240	1210	65
4.55	1220	1200	1190	1170	1180	1180	1190	1240	1200	70
5.0	1300	1240	1230	1220	1220	1220	1240	1310	1230	75
	(704·4)	*(671·1)*	*(665·5)*	*(660·0)*	*(660·0)*	*(660·0)*	*(671·1)*	*(710·0)*	*(665·5)*	
5.5	1180	1160	1140	1140	1130	1150	1170	1200	1180	80
5.10	1200	1180	1160	1150	1150	1150	1180	1230	1190	85
5.15	1240	1220	1240	1200	1200	1210	1200	1280	1230	90
	(671·1)	*(660·0)*	*(671·1)*	*(648·8)*	*(648·8)*	*(654·4)*	*648·8)*	*(693·3)*	*(655·5*	
5.20	1220	1222	1210	1190	1190	1200	1210	1270	1230	95
5.25	1280	1250	1280	1270	1240	1250	1270	1320	1300	100
5.30	1300	1260	1280	1280	1260	1260	1280	1340	1300	105
	(704·4)	*(693·3)*	*(693·3)*	*(693·3)*	*(682·2)*	*(682·2)*	*(693·3)*	*(726·6)*	*(704·4)*	
5.35	1340	1350	1360	1350	1300	1310	1380	1390	1400	110
5.40	1380	1430	1460	1440	1380	1410	1440	1450	1440	115
5.45	1420	1450	1480	1470	1380	1410	1440	1460	1490	120
	(771·1)	*(787·7)*	*(804·4)*	*(798·8)*	*(748·8)*	*(765·5)*	*(782·2)*	*(793·3)*	*(810·0)*	
5.50	1450	1460	1480	1480	1420	1420	1460	1480	1500	125
5.55	1520	1540	1550	1540	1460	1500	1540	1490	1550	130
6 0	1550	1560	1560	1580	1440	1500	1500	1480	1530	135
	(843·3)	*(848·8)*	*(848·8)*	*(860·0)*	*(782·2)*	*(815·5)*	*(815·5)*	*(804·4)*	*(822·2)*	
6.5	1600	1580	1600	1610	1550	1550	1580	1560	1580	140
6.10	1600	1620	1610	1640	1560	1580	1600	1590	1610	145
6.15	1680	1660	1670	1670	1600	1610	1620	1640	1650	150
	(915·5)	*(904·4)*	*(910·0)*	*(910·0)*	*(871·1)*	*(876·6)*	*(882·2)*	*(893·3)*	*(898·8)*	
6.20	1660	1620	1630	1630	1580	1600	1600	1700	1620	155
6.25	1680	1700	1680	1620	1640	1660	1640	1630	1610	160
6.30	1700	1700	1710	1700	1640	1680	1690	1700	1660	165
	(926·6)	*(926·6)*	*(932·2)*	*(926·6)*	*(893·3)*	*(915 5)*	*(921·1)*	*(926·6)*	*(904·4)*	
6.35	1710	1690	1710	1700	1660	1650	1700	1710	1680	170
6.40	1700	1710	1730	1720	1680	1680	1720	1730	1700	175
6.45	1760	1720	1750	1740	1700	1720	1740	1770	1720	180
	(960·0)	*(937 7)*	*(954·4)*	*(948·8)*	*(626·6)*	*(9377)*	*(948 8)*	*(965·5)*	*(937 7)*	
6.50	1780	1770	1780	1780	1740	1750	1780	1790	1740	185
6.55	1780	1760	1780	1740	1730	1730	1750	1780	1700	190
7.0	1780	1750	1780	1770	1740	1750	1770	1780	1740	195
	(971 1)	*(954·4)*	*(971·1)*	*(965·5)*	*(945·8)*	*(954·4)*	*(965·5)*	*(971·1)*	*(940 8)*	
7.5	1780	1760	1800	1770	1740	1750	1770	1800	1780	200
7.10	1800	1780	1800	1790	1780	1770	1790	1810	1800	205
7.15	1800	1780	1810	1780	1750	1750	1800	1820	1790	210
	(982 2)	*(971·1)*	*(987·7)*	*(971 1)*	*(954·4)*	*(954·4)*	*(982·2)*	*(993·3)*	*(976 6)*	
7.20	1800	1800	1800	1790	1770	1780	1800	1830	1800	215
7.25	1820	1820	1830	1816	1800	1800	1830	1850	1830	220
7.30	1830	1840	1850	1820	1810	1810	1840	1870	1850	225
	(998·8)	*(1004·4)*	*(1010·0)*	*(993·3)*	*(987·7)*	*(987 7)*	*(1004·4)*	*(1021·1)*	*(1010·0)*	
7.35	1860	1850	1870	1840	1830	1830	1850	1870	1850	230
7.40	1850	1850	1870	1840	1830	1840	1850	1880	1840	235
7.45	1860	1850	1860	1840	1820	1820	1840	1870	1860	240
	(1015·5)	*(1010·0)*	*(1015·5)*	*(1004·4)*	*(993·3)*	*(993·3)*	*(1004·4)*	*(1021·1)*	*(1015·5)*	

Degrees in italics are Centigrade.

The continuous record (Point No. 10) read as follows:—



OBSERVATIONS AFTER TEST.

(*See Figs.* 9 *to* 11.)

On June 29th and July 1st the photographs shown in Figs. 9 to 11 were taken.

On July 1st the load was removed.

The surface of the top of the floor showed a slight crack at the north-west corner.

The plaster on the soffit of the floor was washed off where struck by the jet. The remainder was friable and covered with cracks.

The semi-porous terra-cotta blocks forming the floor were intact.

There was no permanent deflection of the floor after the removal of the load.

The fire had not passed through the floor.

GENERAL ARRANGEMENTS.

The Test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee of the Executive comprising :—

Mr. Ellis Marsland (District Surveyor, Camberwell), *Directing Member.*

Mr. J. Herbert Dyer (Vice-President, National Fire Brigades' Union).

Mr. Oswald C. Wylson, F.R.I.B.A.

Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham).

Mr. A. H. Lister assisted the Sub-Commlttee.

Mr. H. B. Whlte, M.Inst.E.E., superintended in the instrument room, with two assistants.

The Council was represented for the testing operations of June 28th by—

Sir W. Henry Preece, K.C.B., F.R.S.

The Executive was represented for the testing operations of June 28th by—

Mr. Edwin O. Sachs, F.R.S.Ed. (Chairman).

Mr. Percy Collins.

Mr. Max Clarke, F.R.I.B.A.

Mr. James Sheppard (Surveyor, North British and Mercantile Insurance Co.).

The General Body of Members was represented for the testing operations of June 28th by—

Messrs. Walter Dewes, F.R.I.B.A. ; E. J. Fulkes (Royal Insurance Co.) ; S. G. Gamble (Divisional Officer, London Fire Brigade) ; Matt. Garbutt, F.R.I.B.A. ; Frank W. Macey ; Jos. Randall ; Lieut.-Col. Winn, R.E. ; Commandant Welsch (Ghent).

The National Fireproofing Company were represented by—

Messrs. J. F. Cummings ; H. Thornton.

The following visitors attended at the Testing Station, by special invitation of the Executive, during the testing operations of June 28th :—

Messsrs. J. Atherton ; F. J. Ball ; E. F. Cassel ; H. K. Dyson ; E. Faber ; J. Ferguson ; Wm. Goslet ; A. S. Gibbs; T. E.Healy ; (Royal Insurance Co.) ; Percy Hastings ; F. W. Jackson ;

Howard Mercer ; H. A. Matear ; J. W. Newton ; F. W. Nicholson, °N. G. Pennington ; W. Peacock ; Geo. Stubbings (Superintendent Fire Brigade, Great Eastern Railway ; °Sir Thomas D. Pile, Bart. ; Joseph Sabey ; Thomas G. Wilson ; J. C. Workman ; and two representatives of the Superintending Architect, L.C.C.

Signed,

For the Sub-Committee conducting the Test :—
ELLIS MARSLAND (*Directing Member*).

For the General Testing Arrangements Sub-Committee :—
J. HERBERT DYER.

For the Executive :—
JAMES SHEPPARD.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—July 26th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—August 3rd, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 97.

Edited by the Executive.

FIRE TESTS WITH GLASS.

FOUR HORIZONTAL OPENINGS

FILLED IN WITH

WIRED GLASS

BY

MESSRS. PILKINGTON BROS., LTD.,

ST. HELENS AND LONDON.

The Committee's Report.

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LONDON, 1905.

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Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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Gen. Hon. Secretary:

ELLIS MARSLAND, District Surveyor.

Hon Auditor:

HORACE S. FOLKER, F.A.I., Gen. Hon. Sec. Nat. Fire Brigades Union.

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Regent Street W

Offices

WATERLOO PLACE, PALL MALL, LONDON S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

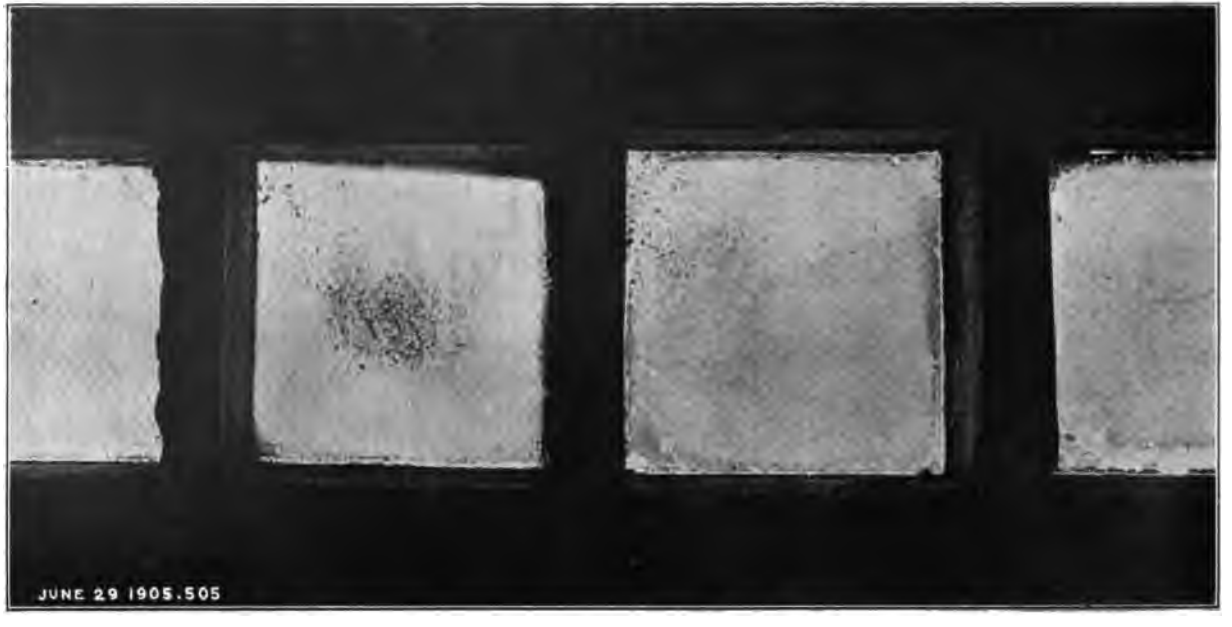


Fig. 10. SKYLIGHTS AFTER THE TEST (FROM BELOW).

NOTE.

THE following test indicates that $\frac{1}{4}$ in. wired glass, $\frac{7}{8}$ in. mesh, in squares 2 ft. by 2 ft., suitably fixed, will prevent the passage of flame for 45 minutes, provided the temperature does not exceed 1660° Fahr. (904·4° *C.*); but it should be borne in mind that a considerable amount of heat passes through the glass.

JAMES SHEPPARD.

LONDON,

July 28th, 1905.

SOTHERAN

THE GENERAL ARRANGEMENTS FOR TESTS.

(MEMORANDUM.)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST No. 64—JUNE 28TH, 1905.

FOUR HORIZONTAL OPENINGS.

FILLED IN WITH

WIRED GLASS

BY

MESSRS. PILKINGTON BROS., LTD.,

ST. HELENS AND LONDON.

OBJECT OF TEST.

To record the effect of a fire of three-quarters of an hour duration on Pilkington's wired glass, ¼ in. thick (0·0063 *m.*) fixed horizontally as skylights. The temperatures to reach 1,500° Fahr. (815·5° *C.*), but not to exceed 1650° Fahr. (898·8° *C.*), followed by the application of water for two minutes, with the view of being classed as affording temporary protection (Class A).

Note.—The squares of wired glass, four in number, to be placed horizontally as skylights, two glazed in elm frames and two into steel frames, resting in rebates of elm frames.

The squares in the elm frames to have a sight measurement of 2 ft. by 2 ft. (0·6095 *m.* by 0·6095 *m.*), described as Nos. 3 and 4. (Fig. 5.)

The squares in the steel frames to have a sight measurement of 2 ft. 1½ in. by 2 ft. 1½ in. (0·6476 *m.* by 0·6476 *m.*), described as Nos. 1 and 2. (Fig. 5.)

SUMMARY OF TEST.

Immediately on lighting the gas the glass in each of the four frames cracked in various directions with slight but sharp reports. Beyond this no perceptible change occurred in either of the squares of glass, except that between the twelfth and fifteenth minutes small thin flakes came off the upper surface of the glass in square No. 4 in some places.

The inside face of the elm frames were charred from ½ in. (·0127 *m.*) to ¾ in. (·019 *m.*) in depth, and the fixing beads on the outside were twisted and displaced. The steel frames were not perceptibly affected.

On the application of water the glass in each of the frames developed hair cracks all over, but water did not pass through either of the squares of glass. A slight amount of smoke found its way round the elm frames, but fire did not pass through either the glazing or frames at any point.

Water was thrown on the top of the squares of glass but did not pass through. Each of these squares had sagged in the centre from an eighth to a quarter of an inch (·0031 to ·0063 *m.*).

DESCRIPTION OF THE TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The testing chamber was located at the Committee's New Testing Station, being the northern portion of hut No. 1.

The chamber was constructed as shown of stock brick, and measured internally 10 ft. (3·048 *m.*) by 3 ft. 8 in. (1·117 *m*).

The underside of the beams forming the frame for the skylights was 7 ft. 6 in. (2·286 *m.*) above the floor of the chamber.

There was a door opening in the north wall of the chamber measuring 2 ft. (·609 *m.*) by 6 ft. (1·829 *m.*), and one in the south wall measuring 2 ft. (·609 *m.*) by 2 ft. (·609 *m.*), which was glazed with a sheet of clear wired glass.

There was also an observation hole in the east wall.

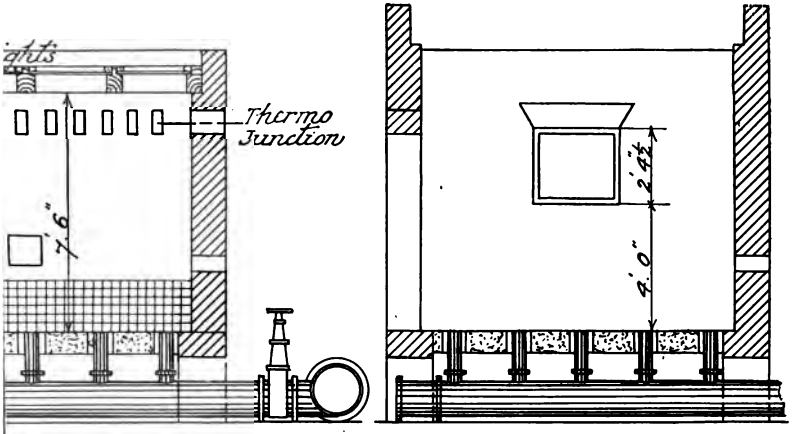
The fuel used was gas produced at the station, the supply being regulated by valves and dampers.

The gas was admitted into the testing chamber through a honeycomb of fire bricks, as shown.

Two Roberts-Austen pyrometers were used for recording the temperatures, the instruments being used for the observation records at points 7 and 8, and for continuous record at point 9.

There were ventilation holes in the upper portions of both the northern and eastern walls of the chambers.

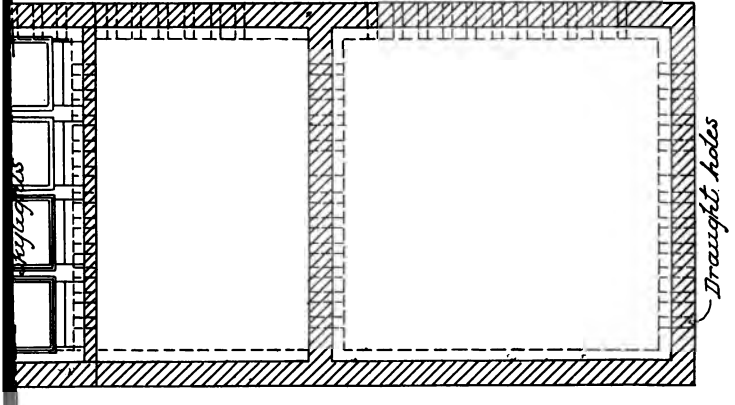
The photographs were taken by daylight.



TION CD

SECTION E.F

Note Points marked 7.8.9
are thermo Junctions attached to wires
leading to Pyrometers No 9 self recording



PLAN OF ROOF

The stream of water was applied through a hose and branch with ¾ in. (·019 *m.*) nozzle, supplied from a small steam fire engine equipped with a pressure gauge.

CONSTRUCTION OF THE SKYLIGHTS.

(*See Figs.* 1 *to* 7.)

The fixing of the skylights was completed on June 24th, 1905.

The openings for the skylights were formed with 9 in. by 6 in. (·228 by ·152 *m.*), elm frames dividing the roof of the chamber into four lights marked Nos. 1, 2, 3, and 4, the two on the east side measured 2 ft. by 2 ft. (·609 by ·609 *m.*), and the two on the west side measured 2 ft. 1½ in. by 2 ft. 1½ in. (·647 *m.* by ·647 *m.*), sight opening in each case.

The upper portions of the frames were rebated as shown to receive glass or angle iron frames.

The two squares of glass on the east side were glazed directly into the elm frames with asbestos and plaster, the glass having a bed 1¾ in. (·0444 *m.*) wide on the rebates on all sides, secured by elm beads 2 in. by 1¼ in. (·05 *m.* by ·031 *m.*), nailed to the frames.

The two squares of glass on the west side were glazed directly into 2 in. by 2 in. by ½ in. (·050 by ·050 *m.* by ·0127 *m.*) angle iron frames, which were bedded with asbestos and plaster into rebates in the elm frame, the glass was bedded into the angle iron frames with asbestos and plaster, and secured by wrought iron fillet 1 in. by ½ in. (·0254 *m.* by ·0127*m.*) screwed to the angle iron. The glass had a bed 1¾ in. (·0444 *m.*) wide on the angle iron on all sides.

The glass in the wood frames Nos. 3 and 4 was ¼ in. (·006 *m.*) thick, known as "Patent polished wired glass."

The glass in the iron frame No. 2 was ¼ in. (·008 *m.*) thick, known as "Patent cast wired glass," and that in the iron frame No. 1 was also ¼ in. (·006) thick, known as "Patent rolled wired glass."

The wire netting embedded in the glass had a ⅞ in. (·0222 *m.*) mesh in each case.

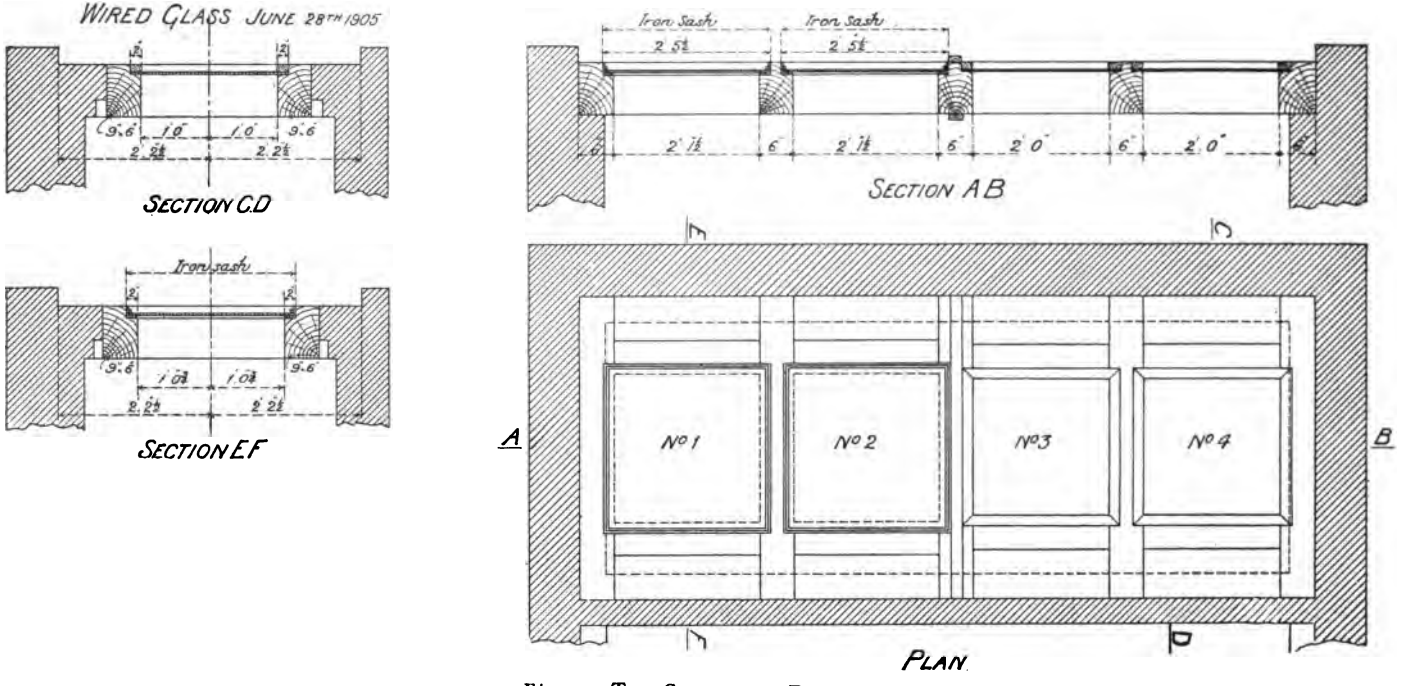


Fig. 5. THE CASEMENTS, DETAILS.

THE TEST.

The test was made on Wednesday, June 28th, 1905. The following being a log of the Test :—

At 3 p.m., June 28th, the meteorological observations taken at the Botanic Gardens, Regent's Park, read as follows :—

State of weather, somewhat cloudy ; wind, S.W. ; barometer, 29·77 in. (0·76 *m.*) ; attached thermometer, 69° Fahr. (20·5° *C.*) ; dry bulb, 72·5° Fahr. (22·5° *C.*) ; wet bulb, 62° Fahr. (16·6° *C.*).

Remarks : Fine afternoon.

OBSERVATIONS.		Minutes Elapsed.
2.0 p.m.	The gas was lighted and the test commenced. Immediately after, each of the squares of wired glass cracked with sharp reports, the cracks passing completely across the squares. The cracking continued up to 2.10 p.m.	
2.12 p.m.	Small flakes came off the upper surface of square No. 4 in some places. This continued until 2.15 p.m. These flakes were scattered as small splinters of glass.	12
2.20 p.m.	The elm beads on the outside of square No. 3 holding the glass in position twisted and were partly displaced.	20
2.30 p.m.	Indications of smoke and heat passing round the elm frames of squares Nos. 1 and 2. This continued with very slight increase up to 2.45 p.m.	30
2.45 p.m.	Gas was turned off.	45
2.48 p.m.	Water was applied from a ¾ in. nozzle (0·019 *m.*) with a pressure of about 45 lbs. (3·06 atms.) to the interior of the chamber.	48
2.50 p.m.	Water was turned off.	50
2.55 p.m.	Water was poured on the horizontal surface of squares Nos. 1 to 4, and remained on the glass. No part of the glass in either of the lights was displaced, other than the small flakes above described, and no fire or water passed through the glass or frames.	55

TEMPERATURES.

The temperatures read from observations records off pyrometer junction points No. 7 and No. 8 were as follows:—

Time.	Inside. No. 7.	Inside. No. 8.	Minutes Elapsed.
p.m.	Fahr. degs.	Fahr. degs.	
2.0	—	—	—
2.03	600	600	3
2.06	700	650	6
2.09	780	700	9
	(*415·5*)	(*371·1*)	
2.12	900	860	12
2.15	930	860	15
2.18	980	1200	18
	(*526·6*)	(*648·8*)	
2.21	1110	1220	21
2.24	1150	1350	24
2.27	1160	1430	25
	(*626·6*)	(*776 6*)	
2.30	1200	1500	30
2.33	1280	1500	33
2.36	1340	1540	36
	(*726·6*)	(*837·7*)	
2.39	1400	1600	39
2.42	1400	1560	42
2.45	1440	1660	45
	(*782·2*)	(*904·4*)	

* Degrees in italics are Centigrade.

At 2.45 p.m. the reading on the automatic record from point No. 9 was 1660° Fahr. (904·4° *C.*).

OBSERVATIONS AFTER TEST.—July 1st.

Inside.

Portions of the inner 4½ in. (·114 *m.*) of the 9 in. (·229 *m.*) brick wall across chamber to right of arch over window, and a portion also of the arch over window opening was knocked down by the jet of water.

The beams forming frame to skylights were charred to a depth of ½ in. to ¾ in. (0·0127 and 0·019 *m.*).

The glass was cracked and starred all over in each of the four lights, but there were no holes. The glass in each case bulged inwards.

OUTSIDE.

The two iron frames were intact and the glass was *in situ*, but bulged inwards.

The wooden beading round the frames was not charred, but two of the fillets holding the glass in position were loose in each light and one was buckled.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee of the Executive, comprising :—

Mr. James Sheppard (Surveyor, North British and Mercantile Insurance Company), *Directing Member.*
Mr. Max Clarke, F.R.I.B.A.
Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham).

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room, with two assistants.

The Council was represented for testing operations of June 28th by—

Sir W. Henry Preece, K.C.B., F.R.S.

The Executive was represented for testing operations of June 28th by—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).
Mr. J. Herbert Dyer (Vice-President, National Fire Brigade Union).
Mr. Oswald C. Wylson, F.R.I.B.A.
Mr. Percy Collins.
Mr. Ellis Marsland (District Surveyor, Camberwell).

The General Body of Members was represented by—

Messrs. Walter Dewes, F.R.I.B.A.; E. J. A. Fulkes (Royal Insurance Company); S. G. Gamble (Divisional Officer of the London Fire Brigade); Matt. Garbutt, A.R.I.B.A.; Frank W. Macey; Jos. Randall; Lieut.-Colonel Winn, R.E.; Commandant Welsch (Ghent).

Fig. 6. THE SKYLIGHTS, VIEW BEFORE TEST (FROM ABOVE).

Fig. 7. THE SKYLIGHTS, VIEW DURING TEST (FROM ABOVE).
Time 2.39 *p.m.*

Fig. 8. THE SKYLIGHTS, VIEW AFTER TEST (FROM ABOVE).

Fig. 9. THE SKYLIGHTS, VIEW AFTER TEST (FROM BELOW).

Messrs. Pilkington Bros. were represented by—

Me srs. Wm. Lee Pilkington; David W. Ames.

The following visitors attended at the Testing Station by special invitation of the Executive during the Testing Operations of June 28th :—

Messrs. J. Atherton; F. J. Ball; E. F. Casel; H. K. Dyson; E. Faber; J. Ferguson; Wm. Goslet; A. S. Gibbs; T. E. Healy (Royal Insurance Company); Percy Hastings; F. W. Jackson; Howard Mercer; H. A. Matear; H. W. Nicholson; J. W. Newton; N. G. Pennington; Sir Thomas D. Pile, Bart.; W. Peacock; Geo. Stubbings (Superintendent of the Fire Brigade, Great Eastern Railway); Joseph Sabey; Thomas G. Wilson; J. C. Workman; and two Representatives of the Superintending Architect, L C.C.

Signed,

For the Sub-Committee conducting the Test :—
JAMES SHEPPARD, *Directing Manager.*

For the General Testing Arrangements Sub-Committee :—
MAX CLARKE.

For the Executive :—
ELLIS MARSLAND.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—July 31st, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—August 8th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

SOUTHWOOD, SMITH & CO., LTD., LONDON, E.C.

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FLAT

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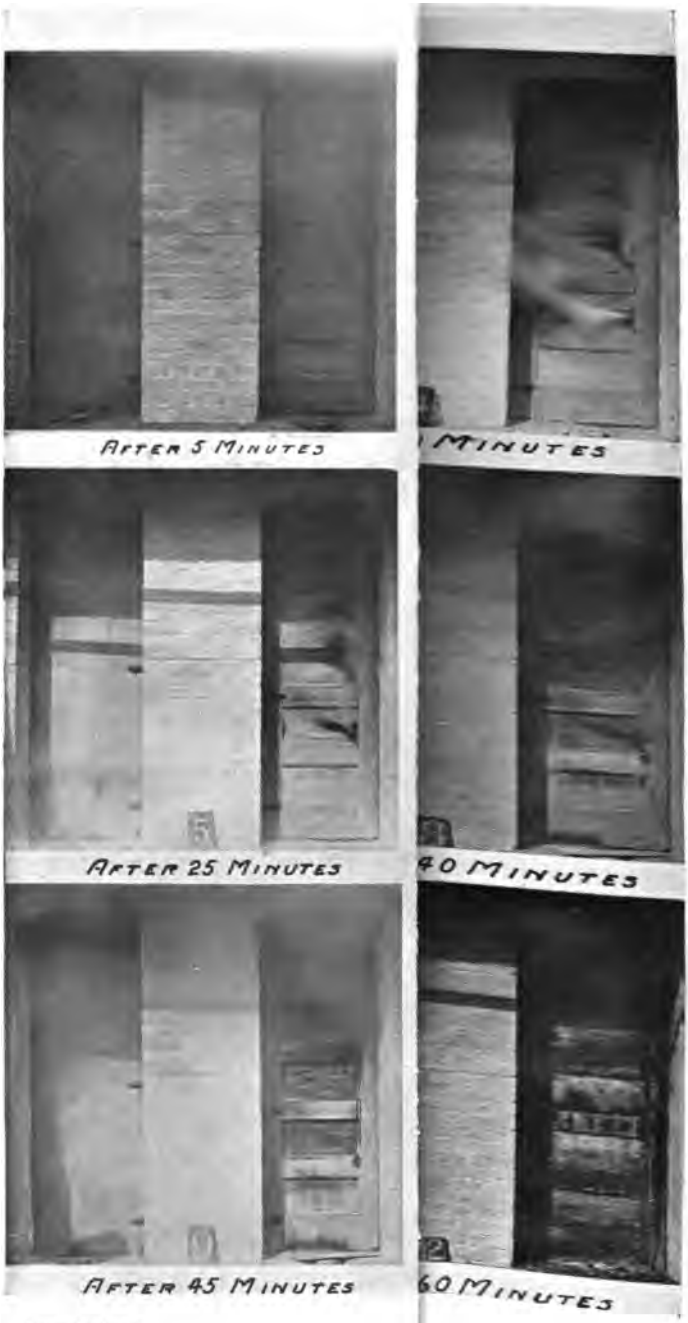

Frontispiece.]

"*RED BOOKS*" *of the*

BRITISH FIRE PREVENTION COMMITTEE.—No. 98.

Edited by the Executive.

FIRE TESTS WITH DOORS.

TWO DOORS

MADE BY

THE GILMOUR DOOR COMPANY, LTD.,

TRENTON, CANADA, AND LONDON.

(*a*) A SOLID 2-IN. COMPOSITE DOOR WITH A FLAT SURFACE BOTH SIDES (OAK FACED),

AND

(*b*) A FIVE-PANELLED 2-IN. COMPOSITE DOOR, MOULDED BOTH SIDES (OAK FACED).

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(*Founded 1897—Incorporated 1899*),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

Fig. 24. THE DOORS. VIEW AFTER TEST (FROM INSIDE).

COUNCIL.

Chairman of the Executive:

EDWIN O. SACHS F.R.S.Ed., Archt., Vice-Pres. Nat. Fire Brigades' Union.

PROFESSOR ARCHIBALD BARR, D.Sc., M.Inst.C.E, Glasgow University.
SIR C. PURDON-CLARKE, C.I.E., F.S.A., F.R.I.B.A., Victoria and Albert Museum.
SIR JOHN COCKBURN, K.C.M.G., M.D., late Premier of South Australia.
H. H. COLLINS, F.R.I.B.A., F.S.I., District Surveyor; Alderman, Boro' of Paddington.
SIR W. MARTIN CONWAY, M.A., F.S.A.
ALFRED DARBYSHIRE, F.S.A., Past-Vice-Pres. Royal Institute of British Architects.
MAJOR-GENERAL E. R. FESTING, C.B., F.R.S., late Victoria and Albert Museum.
SIR DOUGLAS FOX, J.P., Past-President, Institution of Civil Engineers.
W. A. HART, M.V.O., Great Western Ry.
SPENCER HARTY, M.Inst.C.E., City Surveyor, Dublin.
W. T. HATCH, M.Inst.C.E., Chief Engineer, Metropolitan Asylums Board.
W. H. HUNTER, M.Inst.C.E., Chief Engineer, Manchester Ship Canal.
A. B. McDONALD, M.Inst.C.E, City Engineer, Glasgow.
C. E. NOVERRE, London Manager, Norwich Union Fire Office.
SIR W. HENRY PREECE, K.C.B., F.R.S., late Engineer-in-Chief, General Post Office, Past-Pres. Inst. of Civil Engineers.
JOHN PRICE, M.Inst.C.E., F.S.I., City Surveyor, Birmingham.
GUY PYM, J.P., D.L., M.P., North British and Mercantile Insurance Company.
SIR BOVERTON REDWOOD, F.R.S.Ed., F.I.C., Adviser on Petroleum to the Home Office.
W. E. RILEY, F.R.I.B.A., The Architect, London County Council.
E. G. RIVERS, M.Inst.C.E., Chief Engineer H.M. Office of Works.
ALEXANDER SIEMENS, M.Inst.C.E., Past-Pres. Inst. Electrical Engineers.
SIR JAMES WEEKS SZLUMPER, M.Inst.C.E.
SIR JOHN TAYLOR, K.C.B., Consulting Architect, H.M. Office of Works.
ROBERT VIGERS, Past President, The Surveyors' Institution.
ARTHUR WHITELEGGE, C.B., M.D., Chief Inspector of Factories, Home Office.
SIR JAMES WILLIAMSON, C.B., Director of H.M. Dockyards.
SIR HENRY TRUEMAN WOOD, M.A., Secretary, Society of Arts.

Executive:

MAX CLARKE, F.R.I.B.A.; PERCY COLLINS;
J. HERBERT DYER, Vice-Pres. Nat. Fire Brigades' Union;
CHARLES E. GOAD, M.Am.Soc.C.E., M.Can.Soc.C.E.;
LIONEL J. LANGRIDGE, A.Inst.E.E.; ROBERT MOND, M.A., F R.S Ed.;
J. W RESTLER, M.Inst.C.E., Dep.-Chief Eng. Metropolitan Water Board;
E. de SEGUNDO, A.M.Inst.C.E.; OSWALD C. WYLSON, F.R.I.B.A.;
JAMES SHEPPARD, A.Inst.E.E., Surveyor North British and Merch. Ins. Co.

Gen. Hon. Secretary:

ELLIS MARSLAND, District Surveyor.

Hon Auditor:

HORACE S. FOLKER, F.A.I., Gen. Hon. Sec. Nat. Fire Brigades Union.

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Regent Street, W.

Offices:

WATERLOO PLACE, PALL MALL, LONDON, S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 20. THE DOORS. VIEW BEFORE TEST (FROM OUTSIDE)

Figs. 21. THE DOORS. VIEW AT 3.33 P.M. (FROM OUTSIDE).

NOTE.

In these days, when the multiplicity of nostrums for sale to the public is increasing by leaps and bounds, the practitioner will do well to make what inquiry he can as to the various statements made by manufacturers of so-called aids to fire-resisting construction. The reports of the Committee are an attempt to assist the inquirer by stating facts in each case as briefly as possible as to the various materials tested.

MAX CLARKE.

July 24th, 1905.

Fig. 22. THE DOORS. VIEW AT 3.40 P.M. (FROM OUTSIDE).

Fig. 23. THE DOORS. VIEW DIRECTLY AFTER THE TEST (FROM OUTSIDE).

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TESTS NOS. 66 & 67—JUNE 28TH, 1905.

(*a*) A Solid 2-in. Composite Door, with a Flat Surface both sides (Oak faced).

(*b*) A Five-Panelled 2-in. Composite Door, moulded both sides (Oak faced).

OBJECT OF TEST.

To record the effect of a fire of 60 minutes duration at a temperature gradually increasing to 1500° F. (815·5 c.), followed by the application of water for two minutes on the fire side, with the view of being classified as affording temporary protection (class B).

Note.—The door openings were to be approximately 2 ft. 6 in. by 6 ft. 10 in. (0·7619m. by 2·0827m.)

SUMMARY OF TEST.

SOLID DOOR.

The inner portions of the door and the woodwork forming the centre were carbonised and destroyed, the outer veneer curled on the face and cracked at the joints. The fire did not pass through the door.

Classification as affording "Temporary Protection" (class B) was obtained.

PANELLED DOOR.

After 51 minutes flame came through under bottom of door.

After 54 minutes the outer face of the door burst into flame all over.

Almost the whole door was destroyed and fell on the application of water at the end of the test.

Classification was not obtained.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 13 *to* 16.)

The testing chamber was located at the Committee's Testing Station and was known as No. 1 Hut.

The hut was constructed as shown of stock bricks built in lime mortar and the portion used for this test measured 10 ft. by 10 ft. (3·048 m. x 3·048 m.).

The ceiling was 9 ft. (2·7431 m.) above the pavement of the hut and was constructed of concrete.

The hut was divided as shown on plan by a brick wall 14 in. (0·3555 m.) thick with two openings in it, each about 2 ft. 6 in. wide (0·7619 m.) by 6 ft. 10 in. high (2·0827 m.); it was 13 in. (0·3301 m.) back from the main wall. The wall was carried up to the ceiling. The two openings were arched over in two half brick rings on the outside and with concrete lintels on the inside.

The fuel used was gas produced at the Station and the supply was regulated by valves and dampers.

The gas was admitted through two mixing chambers of fire bricks as shown.

Two Roberts Austen pyrometers were used for recording temperatures, one to take four observation records from points Nos. 1, 2, 3, and 4, points 2 and 3 being outside the doors and the others on the fire side of the doors. The other pyrometer was used for the automatic record from point No. 5. (*See roof plan*).

There were observation holes in the east and south walls, the latter covered by a movable iron shutter.

The draught holes were in the north, east, and south walls.

The photographs were taken, some by daylight and some by flashlight.

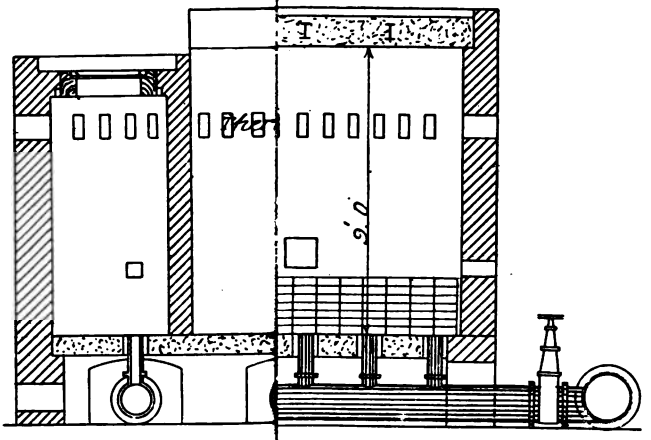
Water was applied from a small steam fire engine through a branch with a ¾-in. nozzle.

CONSTRUCTION OF THE DOORS.

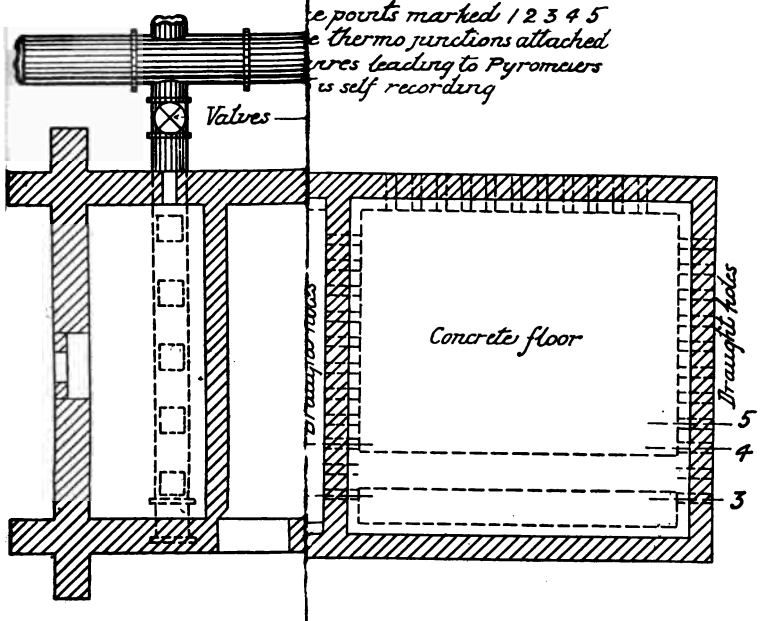
(*See Figs.* 17 *to* 19.)

The doors were constructed on the Gilmour Hardwood veneered or sheathed principle. The core of the frame of the

DOOR TEST



LONGITUDINAL SECTION



HALF PLAN

opp. page 8.

panelled door and the core of the whole of the solid door being made of strips of Canadian Pine, $\frac{7}{8}$ in. thick (·0222 m.) laid grain against grain and glued together.

The North (left-hand) "Solid" door was made quite flush or flat on both sides, the core strips being fixed vertically in the style portions and horizontally in the centre. (*See detail.*) Surrounding the core on both faces and on the edges was a sheet of Asbestos board, $\frac{1}{8}$ in. thick (·0031 m.), fixed with fine French nails 1 in. long (·0254 m.); on this was glued and pressed by hydraulic pressure a veneer of oak $\frac{3}{16}$ in. thick (·0047 m.). The total thickness of the door was 2 in. (·0508 m.).

The South (right hand) door was constructed with five horizontal panels, the finished thickness of the panels being $\frac{1}{2}$ in. (.0127 m.), the frame constructed as above, and the panels of five thicknesses; the centre core was pine, on either side of which was a sheet of asbestos, as above described, and on the outside a veneer of oak was glued all as described for the "Solid" door. The total thickness of the door was $1\frac{3}{4}$ in. (·0444 m.). The frames were in each case 4 in. by 3 in. (·1016 m. by ·0762 m.) of oak with $\frac{1}{2}$ in. rebate (·0127 m.) secured to the brick reveals with deal plugs and screws. The cill was 2 in. thick (·0508 m.).

The size of each door was 2 ft. 6 in. wide (0·7619 m.), by 6 ft. 10 in. high (2·0827 m.)

The frames were pointed all round with lime mortar where fixed into the brick reveals.

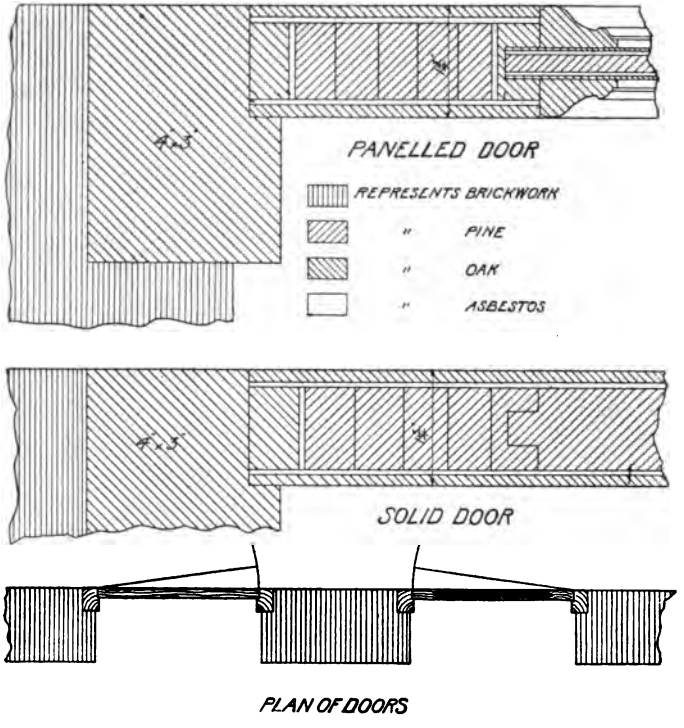
Each of the doors were hung on two $4\frac{1}{2}$ in. (·1143 m.) iron butt hinges and each secured with three 4 in. (·1016 m.) iron neck bolts fixed on the outside. The "Solid" door was fixed in the North opening and the panelled door in the South opening. Both opened inwards towards the fire and were fixed in position on June 17th, 1905.

Note.—The members directing the test have no information as to the wires observed in the "Solid" door. (*See notes after test.*)

PREPARATIONS FOR TEST.

(*Fig.* 20.)

On the afternoon of June 28th at 1.27 p.m., a photograph was taken of the doors from the outside. (*See Fig.* 20.)



Figs. 17 *to* 19. DETAILS OF DOORS.

THE TEST.

(*See Figs.* 20 to 24.)

On June 28th the test was undertaken. The following is a log of the test:—

At 3 p.m. the meteorological observations at the Botanic Gardens, Regent's Park, read as follows :—

State of weather, cloudy; Wind, S.W.; Barometer, 29·77 in. (·76 m.); Attached Thermometer, 69° F. (20·5 c.); Dry bulb, 72·5° Fahr. (22·46 c.); Wet bulb, 62.0° F. (16·6 c.); Remarks, fine afternoon.

OBSERVATIONS ON THE OUTSIDE.

Time.	SOLID DOOR (North).	Minutes elapsed.	PANELLED DOOR (South).
2.45	The gas was lighted.	0	The gas was lighted.
2.46		1	Smoke coming through joint between top of door and frame.
2.50	Smoke coming out under bottom of door which did not fit down close to sill.	5	
2.53		8	Steam or vapour coming through the joint top of second panel from bottom and right of third panel from bottom and both sides of bottom panel.
2.57	Loud cracking noise from door.	12	
3.0		15	Smoke or vapour coming through right joints of 3 centre panels in a regular jet. Panels now very much discoloured.
3.16		31	Second rail from bottom bulging out in centre as if the outer face was coming off and the other rails getting in a similar condition.

Time.	Solid Door (North).	Minutes elapsed.	Panelled Door (South).
3.18		33	Styles becoming in same condition as last described but kept in position by the rebate of frame.
3.20		35	Red glow at sill level but no flame coming through. Veneer of third panel from bottom flaking off in centre Can hold hand on it so not very hot.
3.30		45	Charred all along sill and slight flame coming through joint.
3.32	Outside face bulging outwards and leaving backing. No other defect. Slight blackening of door at sill near bolt.	47	
3.36	Two vertical cracks on the outside face where the joints in veneer are and third one just appearing on left.	51	Flame just coming through under bottom rail.
3.39		54	Face of door bursting into flame all over on outside.
3.43		58	Face burning and flaking off, but door still standing upright.
3.45	No flame yet come through door or joints.	60	
3.46	Water applied on fire side for two minutes without any effect. Test closed.	61	Water applied on fire side for two minutes. Nearly the whole door fell outwards. Test closed.

OBSERVATIONS ON THE INSIDE.

Time.	SOLID DOOR (North.	Minutes elapsed.	PANELLED DOOR (South).
2.46		1	Face of second panel from bottom burning and the veneer coming off exposing the asbestos board.
2.50	Face of door flaming from bottom to about half-way up and the veneer curling off and exposing the asbestos board.	5	
2.58	The face of door in flame over the lower part and gradually extending upwards.	13	The whole of the lower part of door in flames; the veneer coming off; the styles and rails exposing the asbestos board.
3.0	Sharp cracking noise and small particles of the door flying off.	15	Sharp cracking noise and small particles of door flying off.
3.30	The whole of the wood face consumed, exposing the inner asbestos board.	45	The whole of the wood face consumed exposing the asbestos boards.

OBSERVATIONS AFTER TEST.

JULY 1ST, 1905.

Outside.

The veneer on the face of the door in situ but each of the four widths detached from the asbestos board curled outwards and damaged by fire at the top. The outer asbestos board in position.

Outside.

A portion of the veneering on bottom rail and left style still adhering to the asbestos board.

Inside.

The asbestos board on the inner face had fallen down

Inside.

The door was practically destroyed, the woodwork being

and broken in pieces except a strip 15 in. (·3808 m.) high at the bottom, which remained in position.

Very little of the inner wood remaining, and that all carbonised exposing the outer asbestos board. Three vertical wires were exposed.

The frame was in position and charred to a depth of about 1 in. (·0254 m.).

carbonised. The only part remaining in position was the outer asbestos board of the bottom rail and panel, and the styles.

The frame was in position and charred to a depth of about 1 in. (·0254 m.).

TEMPERATURES.

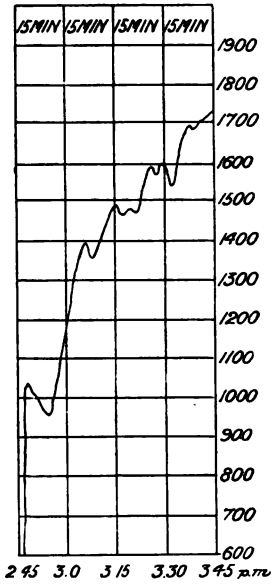
Observations taken from Points Nos. 1, 2, 3, 4, from 2.45 p.m. to 3.45 p.m.

Time.	Inside.		Outside (in Passage.)		Minutes Elapsed
	No. 1.	No. 4.	No. 2.	No. 3.	
p.m.	Fahr.	Fahr.	Fahr.	Fahr.	
2.48	700	800	..	..	3
2.51	1000	950	..	..	6
2.54	930	930	..	..	9
2.57	820	900	..	..	12
	(437·7 C)	*(482·2 C)*	..	..	
3.0	1020	1100	..	..	15
3.3	1060	1240	..	..	18
3.6	1050	1320	..	..	21
3.9	1050	1320	..	..	24
	(565·5 C)	*(715·5 C)*	..	..	
3.12	1050	1350	..	..	27
3.15	1270	1420	..	..	30
3.18	1380	1420	..	..	33
3.21	1420	1500	..	..	36
	(771·1 C)	*(815·5 C)*	..	..	
3.24	1500	1600	..	..	39
3.27	1500	1580	..	..	42
3.30	1480	1520	..	..	45
3.33	1480	1520	..	..	48
	(804·4 C)	*(826·6 C)*	..	..	
3.36	1500	1600	..	..	51
3.39	1540	1600	..	..	54
3.42	1480	1630	..	..	57
3.45	1500	1700	..	..	60
	(815·5 C)	*(926·6 C)*	..	..	

* Degrees in italics are Centigrade.

The junctions at points Nos. 2 and 3 did not indicate above 10° Fahr. (37.7 c.), even when the door caught alight.

Below is given the diagram taken from the continuous record at point No. 5.



GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive, for investigations of this description, and was conducted by a Sub-Committee of the Executive, comprising :—

Mr. Max Clarke, F.R.I.B.A. (*Directing Member*).
Mr. Ellis Marsland, District Surveyor, Camberwell.
Mr. Frank Macey.

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the instrument room with two assistants.

The Council was represented for testing operations of June 28th:
Sir W. Henry Preece, K.C.B., F.R.S.

The Executive was represented for testing operations of June 28th :—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).
Mr. J. Herbert Dyer, Vice-President, National Fire Brigades' Union.
Mr. Oswald C. Wilson, F.R.I.B.A.
Mr. James Sheppard, Surveyor, North British and Mercantile Insurance Co.
Mr. Percy Collins.

The general body of Members was represented by :—

Messrs. Walter Dewes, E. J. A. Fulkes, Royal Insurance Co. ; S. G. Gamble, Divisional Officer, London Fire Brigade ; Matt. Garbutt, A.R.I.B.A., A.M.I.C.E. ; William Grellier, F.R.I.B.A., District Surveyor, Clapham ; Jos. Randall, Lt.-Col. Winn, R.E. ; Commandant Welsch, Ghent.

Messrs. Gilmour Door Co., were represented by :—

Messrs. T. F. Aspden, R. G. Raynham, A. B. Sanderson.

The following visitors attended at the Testing Station by special invitation of the Executive during the testing operations of June 28th :—

Messrs. J. Atherton, F. G. Ball, E. F. Casel, H. K. Dyson, E. Faber, J. Ferguson, Wm. Goslet, A. S. Gibbs, T. E. Healy, Royal Insurance Co. ; Percy Hastings, F. W. Jackson, Howard Mercer, H. A. Matear, H. W. Nicholson, J. W. Newton, N. G. Pennington, W. Peacock, Sir T. D. Pile, Bart., Geo. Stubbings, Supt .Fire Brigade, G.E.Rly. ; Joseph Sabey, Thomas G. Wilson, J. C. Workman, and two representatives of the Superintending Architect, L.C.C.

Signed,

For the Sub-Committee conducting the Test :—
MAX CLARKE (*Directing Member*).

For the General Testing Arrangements Sub-Committee :—
ELLIS MARSLAND.

For the Executive :—
JAMES SHEPPARD.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—July 27th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—August 9th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

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"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 99.

Edited by the Executive.

FIRE TESTS WITH PARTITIONS.

A 2½ IN. PARTITION

FORMED WITH

2⅛ IN. POROUS TERRA-COTTA HOLLOW TILES,

ERECTED BY

THE NATIONAL FIREPROOFING COMPANY,

PITTSBURG, U.S.A.; AND LONDON.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(*Founded 1897—Incorporated 1899*),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibiiities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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Fig. 9. THE PARTITION, VIEW AFTER TEST (FROM INSIDE).

NOTE.

This test indicates that it is possible to provide partitions $2\frac{1}{2}$ in. thick ($2\frac{1}{8}$ in. slabs and $\frac{3}{8}$ in. plastering), having a length of 10 ft. and a height of 8 ft. 10 in. that will prevent the passage of flame and smoke from a fire burning for two and a half hours on the plastered side of the partition, raising the temperature to 1,980° Fahr. (1,082·2° *C.*), and then prevent the passage of water from a steam fire engine jet.

JAMES SHEPPARD.

LONDON,
September 20th, 1905.

Fig. 6. THE PARTITION, VIEW BEFORE TEST (FROM OUTSIDE).

Fig. 7. THE PARTITION, VIEW AFTER TEST. (FROM OUTSIDE).

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST NO. 68—AUGUST 16TH, 1905.

A 2½ IN. PARTITION

FORMED WITH

2⅛ IN. POROUS TERRA-COTTA HOLLOW TILES,

ERECTED BY

THE NATIONAL FIREPROOFING COMPANY,

PITTSBURG, U.S.A.; AND LONDON.

OBJECT OF TEST.

To record the effect of a fire of two and a half hours duration with a gradually increasing temperature to 1·800° Fahr. (982·2° *C.*), but not exceeding 2,000° Fahr. (1,093·3° *C.*), followed by the application of water on the fire side for two minutes with a view to classification as affording "Full Protection" (Class A) of the Standard Table for Fire Resisting Partitions.

The partition, in compliance with the requirements of the above class, to have an area of at least 80 ft. superficial (7·43 *sq. m.*) with a thickness not exceeding 2½ in. (·063 *m.*) when finished.

Note.—The time allowed for drying the partitions was twenty-five days (summer).

SUMMARY OF EFFECT.

During the first five minutes the finishing coat of plaster towards the fire flaked off; the first coat remained in position until water was applied, when most of it was washed away.

In twenty minutes one vertical and one horizontal crack appeared on the surface of the partition away from the fire, increasing to nearly the whole height and length of the partition.

Shorter cracks also appeared from the floor level to each side wall at angles of about 45 degrees ; a similar crack also appeared at the south-east angle from ceiling to side wall. All these cracks slightly increased in length and width during the test.

The cracks passed along the joints and beds and also across the tiles.

The partition bulged towards the fire the maximum at the centre being 2¼ in. (·057 *m.*) ; at the conclusion of the test the bulging was reduced to 2 in. (·0508 *m.*).

The face of one tile on the fire side split off.

Neither fire, smoke, nor water, passed through the partition itself, which remained in position at the conclusion of test.

DESCRIPTION OF TESTING PLANT.

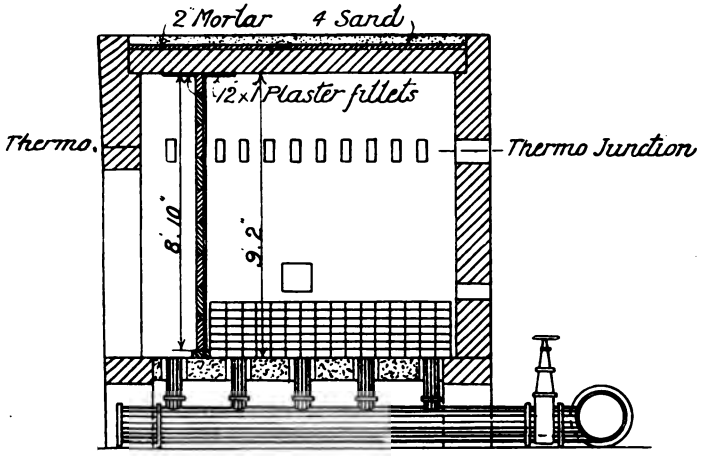
(*See Figs.* 1 *to* 4.)

The testing chamber used was situated at the Committee's present Testing Station, known as "Hut No. 1 (*a*)," being the northern portion of "Hut No. 1."

The hut was constructed with stock bricks and lime mortar, the portion used for this test measured 10 ft. by 10 ft. (3·048 *m.* by 3·048 *m.*), separated from the other portion of the hut by a wall of stock bricks in lime mortar 9 in. (·229 *m.*) thick.

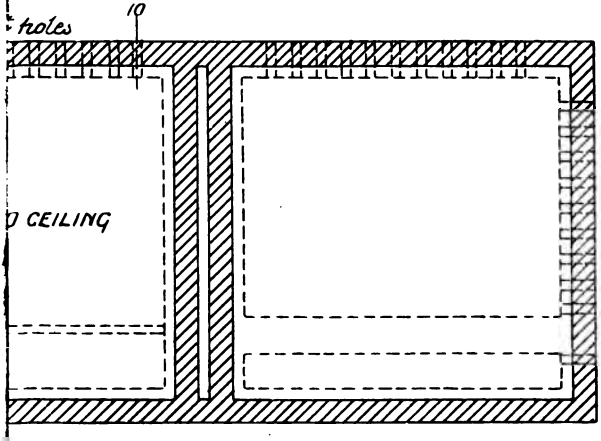
The ceiling was 8 ft. 10 in. (2·69 *m.*) above the floor of the chamber, and was constructed with wood beams 12 in. (·3047 *m.*) deep, placed close together and jointed with lime mortar a layer of similar mortar 2 in. (·0508 *m.*) thick and of sand 4 in. (·1016 *m.*) thick was spread over the top of the beams and their underside for 12 in. (·3047 *m.*) on each side of the partition was roughly plastered with lime mortar containing asbestic.

The opening in the south-west wall of the chamber measured 2 ft. by 6 ft. 6 in. (·61 by 1·98 *m.*), and was open during the test.



CROSS SECTION

NOTE The points marked 6 7 8 & 10
are thermo junctions attached
to wires leading to Pyrometers
No 8 is self recording



ROOF PLAN

opp. page 8.

The fuel used was gas produced at the testing station, and was regulated by valves and dampers.

The gas was admitted through two mixing chambers of fire brick, measuring 8 ft. by 3 ft. 3 in. (2·46 by ·99 *m.*).

There was one observation opening in the north wall, and two small observation holes in the east wall.

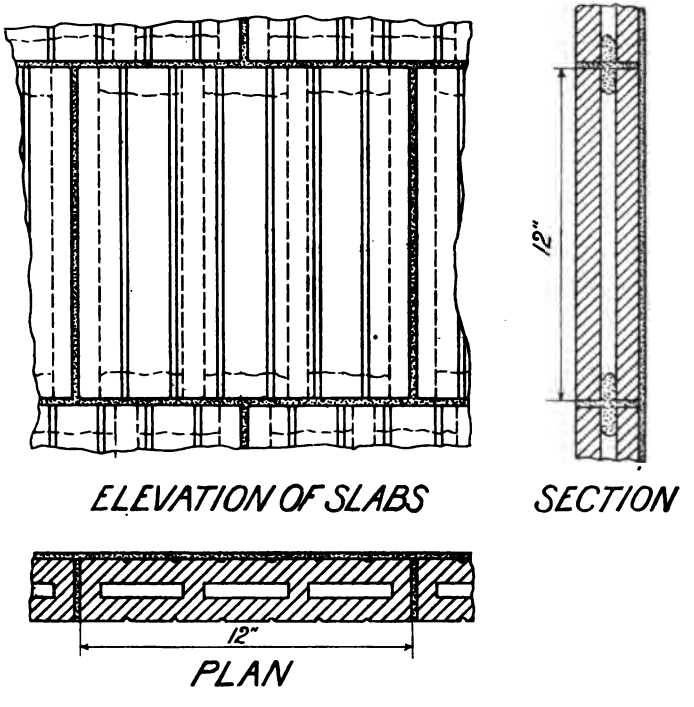


Fig. 5. THE TILES, DETAILS.

The partition was built across the chamber from north to south, the full width and height of the chamber, as shown on plans.

Two Roberts-Austen pyrometers were used for recording temperatures, one for observation records from points Nos.

6, 7, and 10, and one to take a continuous record from point No. 8. Points Nos. 6, 8, and 10 were inside the combustion chamber and No. 7, outside, in the passage. (*See plan.*)

The stream of water was applied to the fire side of the partition through the observation hole in the north wall of the chamber the temporary filling to the opening in which the observation hole was formed being removed for this purpose.

Water was supplied by a small steam fire engine, giving a pressure of 60 lb. per square inch (4·08 *atm.*) at the pumps through a $\frac{3}{4}$ in. (·019 *m.*) nozzle.

CONSTRUCTION OF THE PARTITION.

(*See Figs.* 1 *to* 5.)

The partition was formed of tiles or blocks of porous terra-cotta, each 12 in. by 12 in. (·305 by ·305 *m.*), and averaged $2\frac{1}{8}$ in. (·054 *m.*) thick, three perforations 3 in. long (·076 *m.*) by $\frac{1}{2}$ in. wide (·127 *m.*) passed vertically through each tile, the weight of each being from 12 to 12½ lb. (5·44 to 5·67 *kg.*).

The tiles were soaked in water, and built on a course of stock bricks resting on the floor of the hut, up to the underside of the solid ceiling of wood and plaster and between the walls of the chamber, cement mortar composed of one part of cement to two parts of sand being used for the beds and joints, the mortar in the beds forming dowels in the vertical perforations.

The partition consisted of eight full courses and a filling course about 6 in. (·1524 *m.*) deep.

The partition was plastered in two coats on the fire side with mortar containing a handful of hair and a bushel of asbestic to one yard of clean sand and half a yard of grey lime.

The partition was finished on Saturday, July 22nd, 1905.

The partition, including plaster, was 2½ in. (·063 *m.*) thick.

The terra cotta used for the tiles is stated by the testor to be a mixture of different clays, rendered porous by using sawdust with the clay, the sawdust being consumed during the fireing of the tiles.

THE TEST.

The Test was commenced at 1.30 p.m. on Wednesday, August 16th, 1905. The following being a log of the test :—

At 3 p.m. the meteorological observations taken at the Royal Botanic Gardens, Regent's Park, read as under :—

State of weather, cloudy; Wind, E.S.E.; Barometer, 30·06 in (·762 *m.*); attached Thermometer, 67° Fahr. (19·4° *C.*); Wet Bulb, 60° (15·5° *C.*; Dry Bulb, 69·5 (20.5° *C.*). Remarks : Fine, brisk wind.

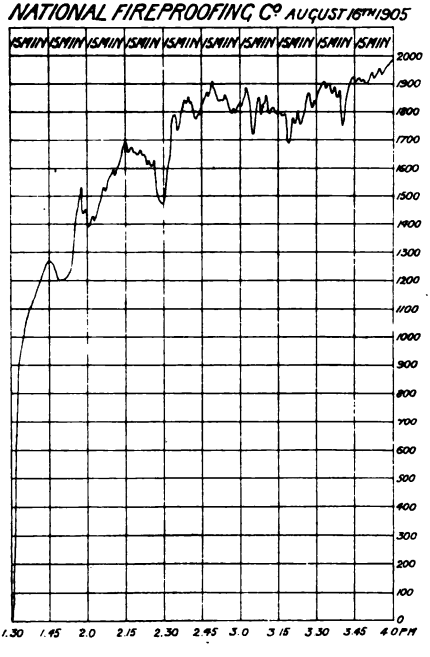
p.m.	OBSERVATIONS.	Minutes elapsed.
1.30	The gas was lighted.	
1.35	Setting coat of plaster had flaked off. Smoke and steam passing over head of partition.	5
1.45	Plaster on ceiling over passage commenced to fall.	15
1.50	Slight cracks appeared along beds and joints.	20
1.55	Cracks increased in length.	25
2.5	Some of the cracks extended across the tiles.	35
2.10	Cracks had passed from lower course to ceiling.	40
2.20	Crack across N.W. angle of partition from floor to wall.	50
2.35	Crack across S.E. angle of partition from floor to wall, existing cracks slightly increased.	65
2.50	Cracks on outer face of partition increased in width, cracks at lower angles nearly ¼ in. (.0063 *m.*) wide.	85
2.55	Smoke that continued to pass over the head of partition and from the wood beam of ceiling increased and ignited at its lower surface where in contact with the partition.	85
3.30	Smoke and gases from the wood beams of ceiling burning freely.	120
3.35	Cracks on outer face of partition closing slightly.	125
4.0	Gas turned off.	150
4.1	Water turned on the inside face of partition, when most of the first coat of plastering was washed away.	151
4.3	Water turned off and test concluded.	153

Bulging of the Partition and the Temperatures on its face away from the Fire.

The following records were taken during the test as to the bulging of the partition (towards the fire), and of the temperature on the outside face of the partition as read from a suspended thermometer.

Time.	Bulging.		Temperature on Face.		Minutes Elapsed.
	Inches.	Metres.	Deg. Fahr.	Deg. Celsius.	
P.M.					
1.40	1/16	·011	—	—	10
1.55	—	—	115	41·1	25
2.00	7/16	·022	—	—	30
2.5	1 1/16	·028	—	—	35
2.15	1 1/8	·038	—	—	45
2.20	1 1/8	·041	115	41·1	50
2.25	1 1/8	·048	—	—	55
2.30	—	—	138	58·8	60
2.35	1 1/16	·049	150	65·5	65
2.45	2	·051	160	71·1	75
2.50	—	—	200	93·3	80
2.55	2 1/16	·057	—	—	85
3.45	2	·051	—	—	135

The continuous self-recording point No. 8 read as follows :—



TEMPERATURES.

The following is a record of the temperatures taken from the points No. 7, 6, and 10:—

Time.	Outside (in Passage).	Inside.		Minutes Elapsed.
	No. 7.	No. 6.	No. 10.	
P.M.	Deg. Fah.	Deg. Fah.	Deg. Fah.	
1.35	—	1080	1220	5
1.40	—	1220	1340	10
1.45	—	1280	1400	15
		(963·3 C.)	(760 C.)	
1.50	—	1280	1390	20
1.55	—	1430	1410	25
2.0	—	1400	1440	30
		(760 C.)	(782·2 C.)	
2.5	—	1510	1530	35
2.10	—	1580	1580	40
2.15	—	1670	1680	45
		(910 C.)	(915·5 C.)	
2.20	—	1680	1630	50
2.25	—	1660	1630	55
2.30	—	1520	1520	60
		(826·6 C.)		
2.35	—	1810	1790	65
2.40	100†	1820	1830	70
2.45	100	1830	1830	75
	(37·7 C.)	(998·8 C.)		
2.50	100	1900	1870	80
2.55	100	1880	1870	85
3.0	170	1880	1890	90
	(76·6 C.)	(1026·6 C.)	(1032.2 C.)	
3.5	175	1910	1950	95
3.10	200	1860	1840	100
3.15	260	1860	1810	105
	(126·6 C.)	(1015·5 C)	(987·7 C.)	
3.20	300	1800	1780	110
3.25	320	1860	1880	115
3.30	360	1900	1910	120
	(182·2 C.)	(1037·7 C.)	(1043·3 C)	
3.35	500	1900	1920	125
3.40	605	1890	1900	130
3.45	670	1930	1930	135
	(354·4 C.)	(1054·4 C.)		
3.50	800	1940	1960	140
3.55	850	1980	1960	145
4.0	960	1980	1940	150
	(515·5 C.)	(1082·2 C.)	(1 60 C.)	

* Degrees in italics are in Centigrade.
† The Notes as to burning of beams should be referred to.

OBSERVATIONS AFTER TEST.

(*See Figs.* 7 and 9.)

The partition was examined on August 17th, 1905, when the permanent bulge in the centre was found to be 2¼ in. (·0571 *m.*).

The face of one tile on the fire side had fallen.

Most of the plaster had been washed away and that remaining was friable. part of the cement mortar in the joints had been washed out by the stream of water.

Note.—The wood beams forming the ceiling were destroyed to a depth of 1½ in. to 2 in. (·038 to ·0508 *m.*), leaving the head of the partition free.

The photographs were taken by daylight and by flashlight.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee of the Executive, comprising :—

Mr. James Sheppard (Surveyor of the North British and Mercantile Insurance Co.), *Directing Member.*

Mr. William Grellier, F.R.I.B.A. (Dist. Surveyor, Clapham).

Mr. Oswald C. Wylson, F.R.I.B.A.

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the instrument room.

The Council was represented for the testing operations of August 16th by—

Major-General R. Robert Festing, C.B., F.R.S.

The Executive was represented for the testing operations of August 16th by—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).

Mr. J. H. Dyer (Vice-Pres. Nat. Fire Brigades' Union).

Mr. Ellis Marsland (District Surveyor, Camberwell), *Gen. Hon. Sec.*

The general body of members was represented for the testing operations of August 16th, by—

Messrs. Walter Dewes, F.R.I.B.A. ; E. J. A. Fulkes (Royal Insurance Co.) ; S. G. Gamble, A.M.Inst.C.E. (Divisional Officer, London Fire Brigade) ; Matt. Garbutt, F.R.I.BA. (Metropolitan Railway) ; Robert P. Notley, F.R.I.B.A. (District Surveyor, Bethnal Green) ; Jos. Randall.

Fig. 8. THE PARTITION, VIEW DURING TEST (FROM OUTSIDE), *after* 115 *minutes*.

Messrs. National Fireproofing Co. were represented by—
Mr. J. F. Cummings.

The following visitors attended the Testing Station by special invitation of the Excutive, during the testing operations of August 16th :—

Messrs. C. Boreham (H.M. Patent Office); D. Christie; E. Catley (General Post Office); H. K. Dyson; A. R. Dyer, A.M.Inst.C.E. (Assistant Divisional Officer, London Fire Brigade); W. H. Francis; F. E. Gould; M. Gould; W. H. Growse; H. P. Gaze; E. Stokes Hand (New York, U.S.A.); Captain Horne; H. W. Monroe, (H.M. Patent Office); Wm. Manning (Assistant Borough Surveyor, Chelsea); P. Mossop; A. Moir (General Post Office); J. C. Stransom (Theatres Branch, L.C.C.); A. Schneider; Lieut. P. O. G. Usborne, R.E. (Royal Engineers' Institute, Chatham); Major J. R. Young, R.E. (Superintendent of Buildings, Woolwich Arsenal).

Signed,

For the Sub-Committee conducting the Test :—
JAMES SHEPPARD (Directing Member).

For the General Testing Arrangements Sub-Committee :—
J. HERBERT DYER.

For the Executive :—
ELLIS MARSLAND.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—September 21st, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—October 3rd, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

SOUTHWOOD, SMITH & CO., LTD., LONDON, E.C.

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Frontispiece.]

"*RED BOOKS*" *of the*

BRITISH FIRE PREVENTION COMMITTEE.—No. 100.

Edited by the Executive.

FIRE TESTS WITH DOORS.

A Steel Rolling Shutter Door

KNOWN AS

THE "KINNEAR" DOOR (U.S.A.),

FIXED BY

MESSRS. A. L. GIBSON & CO.,

LONDON.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(*Founded 1897—Incorporated 1899*),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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Offices:

WATERLOO PLACE, PALL MALL, LONDON, S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 10. THE ROLLER SHUTTER, VIEW AFTER TEST (FROM INSIDE).

NOTE.

THIS test is intended to illustrate the use of suitably constructed light steel revolving shutters in large openings in checking the spread of fire where iron doors would be heavy and cumbersome.

J. HERBERT DYER.

September 15th, 1905.

SOTHERAN

THE GENERAL ARRANGEMENTS FOR TESTS.

(*MEMORANDUM.*)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST NO. 70—AUGUST 16TH, 1905.

A STEEL ROLLING SHUTTER DOOR

KNOWN AS

THE "KINNEAR" DOOR (U.S.A.),

FIXED BY

MESSRS. A. L. GIBSON & CO.,

LONDON.

OBJECT OF TEST.

To record the effect of a fire of 90 minutes' duration at a temperature gradually increasing to 1,800 F. (982·2 *C.*), followed by the application of water for two minutes on the fire side, with the view of being classified as affording "partial protection" (class A.).

Note.—The door opening was to be approximately 9 ft. (2·743 m.) by 8 ft. (2·438 m.) high.

SUMMARY OF TEST.

In one minute the paint on the inside of the shutter began to burn.

In 20 minutes the heat on the outside of the shutter was sufficient to ignite a newspaper placed 12 in. (·30 m.) from the face.

In 47 minutes flame came over the top of the shutter and continued to the end of the test.

The shutter became red hot and the upper part bulged outwards about 6 in. (·15 m.).

The shutter remained in position at the end of the test, but the bulging increased on the application of water.

Flame at no time passed through the shutter or around the sides.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The testing chamber was located at the Committee's Testing Station and was known as No. 1 Hut.

The hut was constructed as shown of stock bricks built in lime mortar and the portion used for this test measured 10 ft. by 10 ft. (3·048 m. by 3·048 m.).

The ceiling was 9 ft. (2·74 m.) above the pavement of the hut and was constructed of concrete.

On the west side and 13 in. (·33 m.) back from the main wall of the hut an opening 9 ft. (2·74 m.) wide and 8 ft. high (2.44 m.) with a concrete lintel over was formed to receive the steel shutter.

There was a door opening on the south side measuring 2 ft. (·61 m.) by 6 ft. (1·83 m.) and was closed by being filled in with brickwork 4½ in. (·114 m.) thick.

The hut was divided as shown on plan by a brick wall 14 in. (0·35 m.) thick.

The fuel used was gas produced at the Station and the supply was regulated by valves and dampers.

The gas was admitted through two mixing chambers of fire bricks as shown.

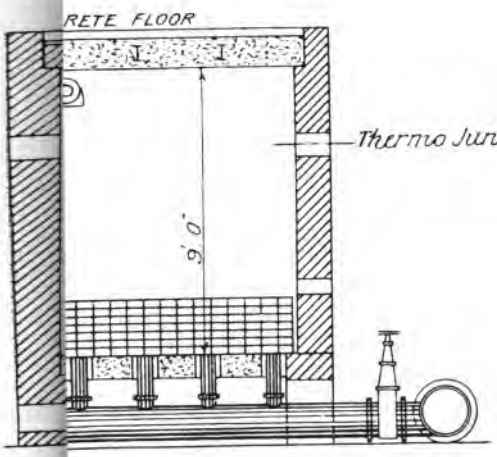
Two Roberts-Austen pyrometers were used for recording temperatures, one to take four observation records from points Nos. 1, 2, 3, 4, and 9, points 2 and 3 being outside the door and the others on the fire side of the door. The other pyrometer was used for the automatic record from point No. 5. (*See roof plan.*)

There were observation holes in the east and south walls, the latter covered by a movable iron shutter.

The draught holes were in the east and south walls.

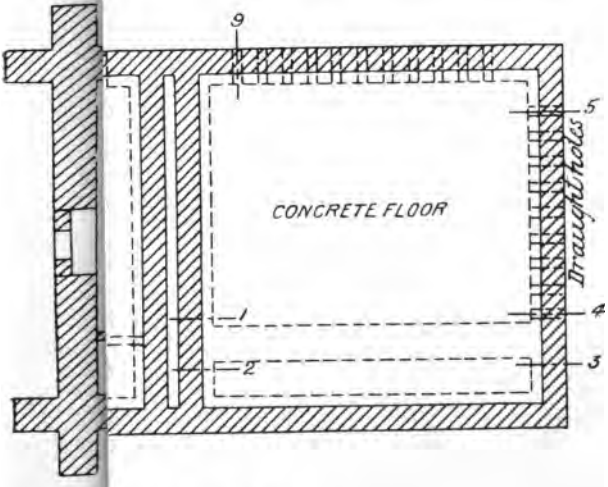
The photographs were taken, some by daylight and some by flashlight.

Water was applied from a small steam fire engine through a branch with a ¾-in. nozzle (·02 m).



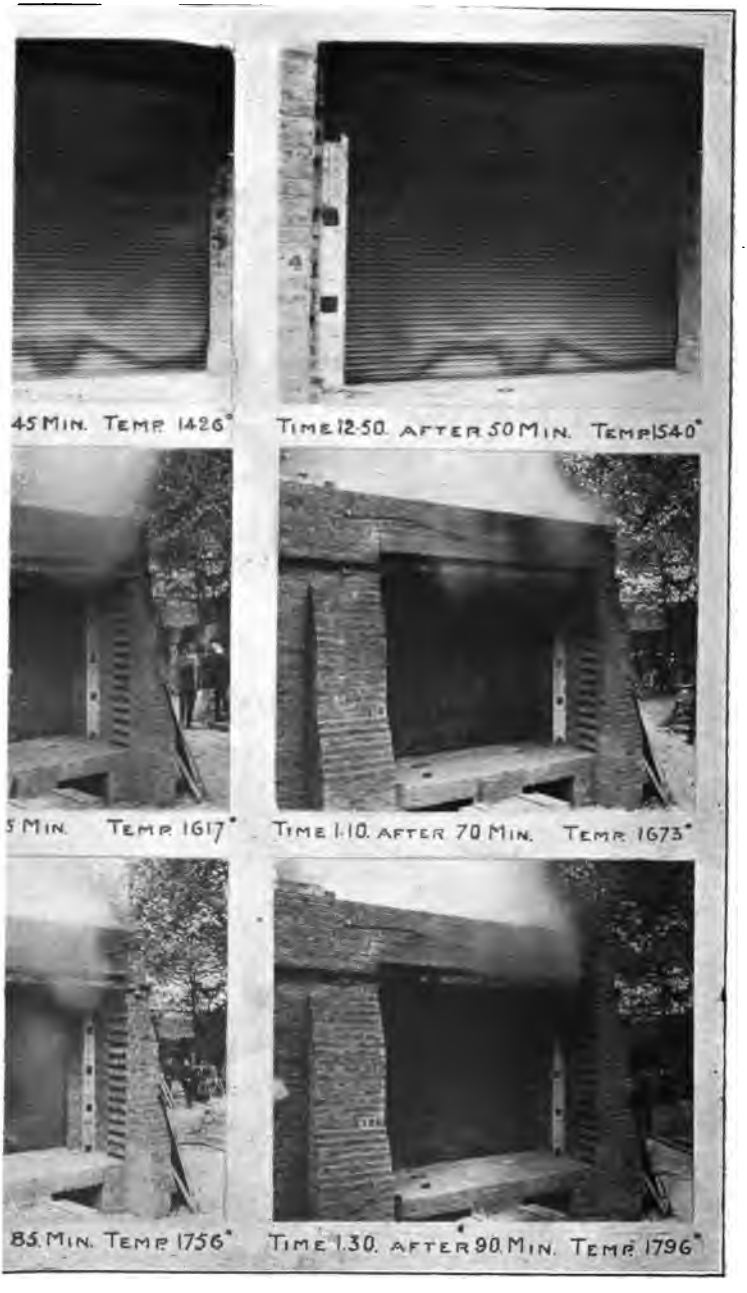
SS SECTION

E The points marked 1 2 3 4 5 & 9 are thermo junctions attached to wires leading to Pyrometers No 5 is self recording



OOF PLAN

opp. page 8.


45 MIN. TEMP. 1426°
TIME 12-50. AFTER 50 MIN. TEMP. 1540°
5 MIN. TEMP. 1617°
TIME 1-10. AFTER 70 MIN. TEMP. 1673°
85 MIN. TEMP. 1756°
TIME 1.30. AFTER 90 MIN. TEMP. 1796°

S DURING TEST.

opp. page 9.

CONSTRUCTION OF THE ROLLING SHUTTER DOOR.

(*See Figs.* 1 to 5.)

The shutter was formed of a series of No. 20 gauge galvanised steel strips each welted one into the other, at the ends of each strip small cast-iron nibs were fixed.

Along the bottom edge of the shutter a double angle iron was fixed. (*See Fig.* 5.)

The shutter was fixed on the inside face of the opening to a hollow drawn steel roller 3½ in. (·09 m.) external diameter having an inner revolving spindle and was supported at each end by a cast-iron bracket bolted through the wall.

At the north end of the roller, gearing with an endless chain was fixed for raising and lowering the shutter.

The roller was covered with a projecting hood constructed of No. 24 gauge steel plate and supported at each end on the brackets to which the roller was fixed.

The sight size of the shutter was 9 ft. (2·74 m.) by 8 ft. (2·44 m.) and it overlapped the opening 2 in. (·05 m.) at each end.

To guide and keep the shutters in position wrought-iron channels constructed of three angle irons bolted together were secured to the brick sides of the opening by ⅜ in. (·01 m.) bolts, the holes in the channel being slotted for expansion. (*Fig.* 5.)

The channels were pointed all round with Portland cement and a cement screed run on floor on which the lower end of the shutter rested.

The shutter was painted.

Note.—The shutter was brought over complete from the United States and was fixed by the testor during the week ending August 5th, 1905.

THE TEST.

(*See Figs.* 6 *to* 10.)

On August 16th the test was undertaken. The following is a log of the test :—

At 3 p.m. the meteorological observations at the Botanic Gardens, Regent's Park, read as follows :—

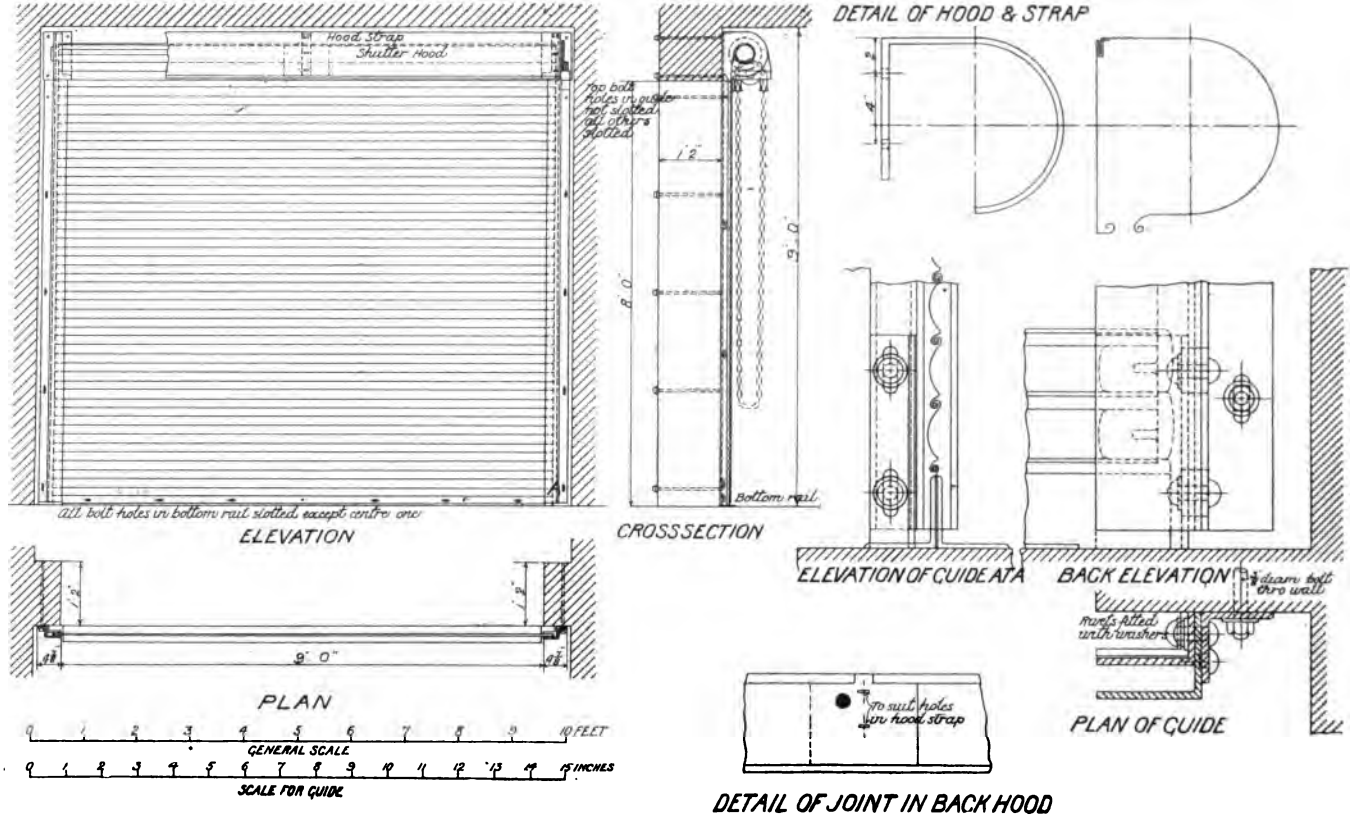


Fig. 5. THE ROLLER SHUTTER, DETAILS.

State of weather, cloudy; Wind, E.S.E.; Barometer, 30·06 in. (·762 m.); Attached Thermometer, 67° F. (19·4 *C.*); Wet Bulb, 60° F. (15·5 *C.*); Dry Bulb, 69.5 F. (20·5 *C.*); Remarks, fine brisk wind.

	OBSERVATIONS.	Minutes elapsed.
NOON.		
12.0	The gas was lighted.	
p.m.		
12.1	The paint on the outside of the shutter began to scorch and smoke, and that on the inside to burn.	1
12.5	The shutter started to buckle slightly. A piece of timber was placed on end about 12 in. (30 m.) from the outside face of the shutter.	5
12.12	Smoke from burning paint coming through over top of shutter.	12
12.15	Particles of burning paint on the outside of the shutter flaking off and falling.	15
12.20	A piece of newspaper was placed on the top of the piece of timber above mentiond.	20
12.35	Side of piece of timber nearest to shutter starting to smoke and smoulder.	35
12.40	Paper caught alight on piece of timber, the timber also started to blaze and was removed.	40
12.45	Slight smoke coming over top of shutter.	45
12.47	Slight flame coming over top of shutter	47
12.50	Upper part of shutter now red hot and flame coming over top.	50
1.5	Dense smoke coming over top of shutter and flakes of burning paint falling, followed by a great burst of flame at south end. The top of shutter at bright red heat.	65
1.10	Flames continuing over the top where shutter had bulged.	70

		Minutes elapsed.
1.12	Flames increasing over top of shutter at south end, also in the middle. Shutter bulging considerably [about 6 in. (·15 m.)], just above the centre, and practically red hot all over.	72
1.20	Flames issuing over top of shutter and projecting beyond the face of cement lintel.	80
1.30	Gas turned off.	90
	Water applied from the inside through the south door for two minutes.	
	Flame at no time passed through the shutter or around the sides, but only over the top.	

TEMPERATURES.

Observations taken from Points Nos. 1, 2, 3, 4, and 9, from 12 noon to 1.30 p.m.

	Outside.		Inside.			Minutes Elapsed.
Time.	No. 2.	No. 3.	No. 1.	No. 4.	No. 9.	
p.m.	Fahr.	Fahr.	Fahr.	Fahr.	Fahr.	
12.5	—	—	800	920	900	5
12.10	100	180	910	980	1000	10
12.15	110	220	1020	1100	1100	15
	(43·3)	*(104·4)*	*(548·8)*	*(593·3)*	*(593·3)*	
12.20	140	300	1080	1120	1180	20
12.25	180	310	1160	1180	1240	25
12.30	120	340	1210	1220	1300	30
	(48·8)	*(171·1)*	*(654·4)*	*(660·0)*	*(704·4)*	
12.35	100	320	1240	1260	1320	35
12.40	140	380	1290	1300	1400	40
12.45	130	420	1400	1400	1400	45
	(54·4)	*(215·5)*	*(760·0)*	*(760·0)*	*(760·0)*	
12.50	180	500	1500	1520	1600	50
12.55	240	540	1520	1550	1580	55
1.0	220	560	1560	1560	1640	60
	(104·4)	*(293·3)*	*(848·8)*	*(848·8)*	*(893·3)*	
1.5	220	570	1590	1580	1680	65
1.10	260	620	1640	1640	1740	70
1.15	290	650	1700	1640	1800	75
	(143·3)	*(343·3)*	*(926·6)*	*(893·3)*	*(982·2)*	
1.20	300	680	1720	1670	1800	80
1 25	360	680	1750	1700	1820	85
1.30	400	700	1790	1740	1860	90
	(204·4)	*(371·1)*	*(976·6)*	*(948·8)*	*(1015·5)*	

Degrees in italics are Centigrade.

Fig. 6. THE ROLLER SHUTTER, VIEW BEFORE TEST (FROM OUTSIDE).

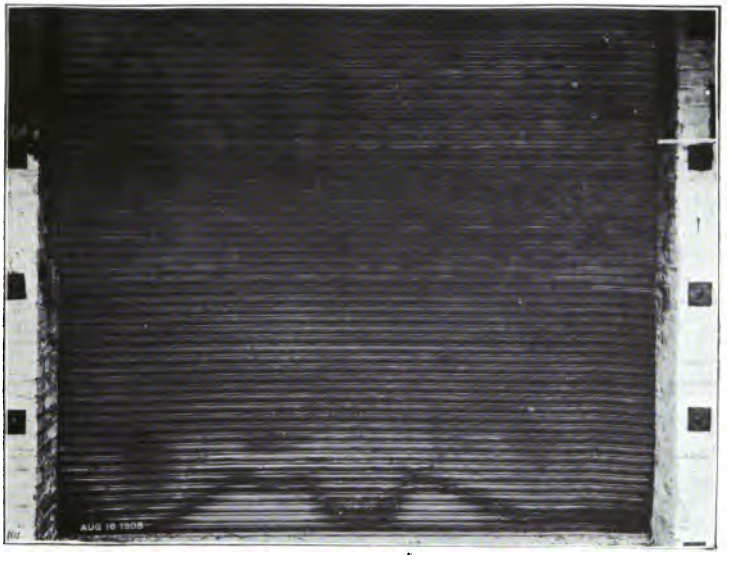
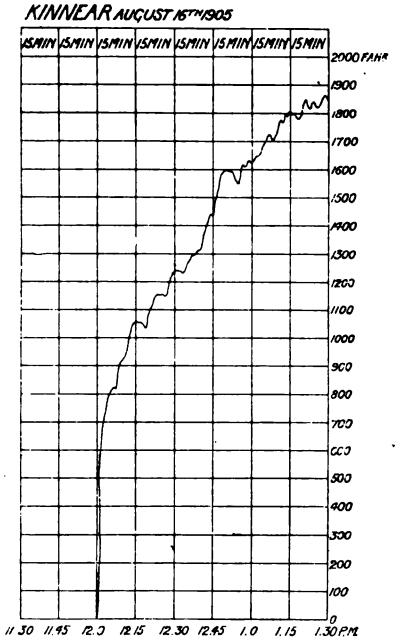


Fig. 7. THE ROLLER SHUTTER, VIEW DURING TEST AFTER 60 MINUTES (FROM OUTSIDE).

The following is the diagram taken from the Continuous Record of the Temperature at Point No, 5.



OBSERVATIONS AFTER TEST.

Observations upon conclusion of test.

The bulge in the shutter had increased to about 9 in. (·23 m.) from the effects of the water being applied.

The pointing was broken away from the iron channels in which the shutter ran.

The shutter remained in position, and did not leave the channels in which it ran.

Observations on Thursday, August 17th.

The channel on the south side remained in position, but that on the north side had drawn away from the brickwork considerably in centre and upper part, and had buckled about $\frac{3}{8}$ in. outwards (·0095 m.).

The hood was drawn down inward by the fire. The roller was deflected downwards about 5 in. in centre.

The double angle iron at bottom of shutter had buckled in places especially about the middle.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee of the Executive, comprising :—

Mr. J. Herbert Dyer (Vice-Pres. National Fire Brigades' Union), *Directing Member.*

Mr. Ellis Marsland (District Surveyor, Camberwell).

Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham).

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Council was represented for the testing operations of August 16th, by—

Major-General R. Robert Festing, C.B., F.R.S.

The Executive was represented for the testing operations of August 16th by—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).

Mr. Oswald C. Wylson, F.R.I.B.A.

Mr. James Sheppard (Surveyor, North British and Mercantile Insurance Co.).

The general body of Members was represented for the testing operations by—

Messrs. Walter Dewes, F.R.I.B.A. ; E. J. A. Fulkes (Royal Insurance Co.) ; S. G. Gamble, A.M.Inst.C.E. (Divisional Officer, London Fire Brigade) ; Matt. Garbutt, F.R.I.B.A. (Metropolitan Railway) ; Robert P. Notley, F.R.I.B.A. (District Surveyor, Bethnal Green) ; Jos. Randall.

Messrs. A. L. Gibson and Co., were represented by—

Messrs. W. Blair ; A. L. Gibson ; W. P. Gibson ; E. H. McCloud ; F. Pope ; A. G. St. John.

The following visitors attended the Testing Station by special invitation of the Executive, during the testing operations of August 16th :—

Messrs. C. Boreham (H.M. Patent Office); D. Christie; E. Catley (General Post Office); H. K. Dyson; A. R. Dyer, A.M.Inst.C.E. (Assistant Divisional Officer, London Fire Brigade); W. H. Francis; F. E. Gould; M. Gould; W. H. Growse; H. P. Gaze; E. Stokes Hand (New York, U.S.A.); Captain Horne; H. W. Monroe (H.M. Patent Office); Wm. Manning (Assistant Borough Surveyor, Chelsea); P. Mossop; A. Moir (General Post Office); J. C. Stransom (Theatres Branch, L.C.C.); A. Schneider; Lieut. P. O. G. Usborne, R.E. (Royal Engineers' Institute, Chatham); Major J. R. Young, R.E. (Superintendent of Buildings, Woolwich Arsenal).

Signed,

For the Sub-Committee conducting the Test :—
J. HERBERT DYER (*Directing Member*).

For the General Testing Arrangements Sub-Committee :—
ELLIS MARSLAND.

For the Executive :—
EDWIN O. SACHS.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—September 27th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—October 9th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

SOUTHWOOD, SMITH & CO., LTD., LONDON, E.C.

"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 101.

Edited by the Executive.

FIRE TESTS WITH FLOORS.

A CEMENT CONCRETE FLOOR

WITH

Bays of Various Aggregates;

THE PORTLAND CEMENT

BEING PROVIDED BY

THE ASSOCIATED PORTLAND CEMENT MANUFACTURERS (1900), LIMITED, LONDON.

Particulars

OF

EXPERIMENTAL FIRE TEST.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897—Incorporated 1899),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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JAMES SHEPPARD, A.Inst.E.E., Surveyor North British and Merch. Ins. Co.

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WATERLOO PLACE, PALL MALL, LONDON, S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

THE GENERAL ARRANGEMENTS FOR TESTS.

(*MEMORANDUM.*)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

NOTE.

At the present time there is a great divergence of opinion as to what material is the most suitable fire-resisting aggregate for concrete to be used in the construction of floors and the like, and it may be said that there are some who would advocate each or any of the aggregates used in the test now reported on. At the same time, there are others who say that each of these aggregates are open to some special objection.

It was with the view of in some degree settling such differences of opinion that this experimental test was undertaken.

The test, however, did not go far enough to draw definite conclusions except to show the entire unreliability of Thames ballast concrete as a suitable material for this method of construction.

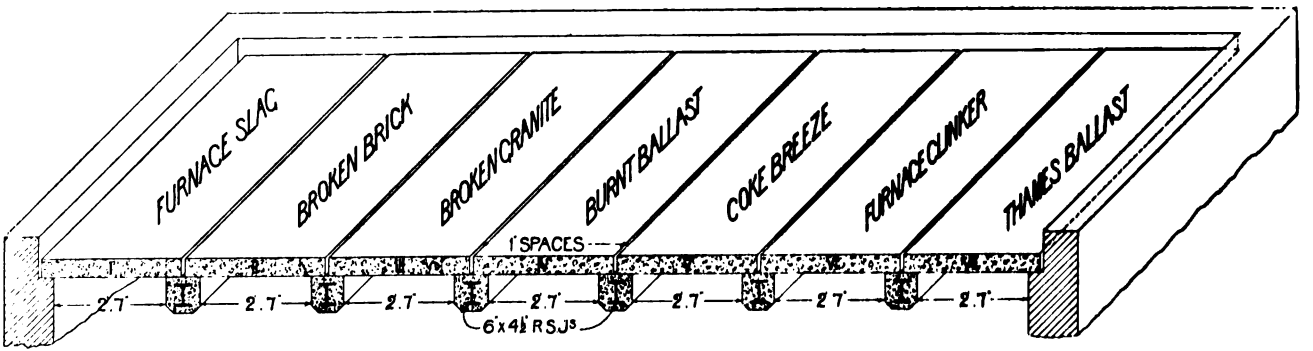
As to the exact relative value of the concrete aggregates other than Thames ballast concrete, no indisputable statement can as yet be made. But this test has been a serious attempt to solve the questions yet at issue, and it is hoped before very long the Committee will be able to undertake further tests on similar lines, which will more definitely elucidate the matter.

The thanks of the Committee are due to the Associated Portland Cement Manufacturers (1900), Ltd., through whose generosity and co-operation the test was made possible.

MAX CLARKE.

London, S.W.
November 27th, 1905.

SOUTHERN



No. I.	No. II.	No. III.	No. IV.	No. V.	No. VI.	No. VII.
Top: Slab cracked across in two places.	Top: Slab cracked across in three places; slight curve downwards.	Top: Slab cracked across in three places; curved downward about ¼ in.	Top: No cracks; not curved downwards.	Top: No cracks; not curved downwards.	Top: Slab cracked across in two places; curved downwards about ¼ in.	Too: Slab cracked across in very many places; curved downward about 2 in.
Underside: Curved downwards ¼ in.; slight cracks visible.	Underside: Curved downwards ¼ in.; slight cracks visible.	Underside: Curved downwards ¼ in.; no cracks visible; about 1 in. washed off by water.	Underside: Not curved downwards; no cracks visible; about 3 in. washed off underside (in parts) by water.	Underside: Not curved; no cracks visible; about 1 in. washed off underside (in parts) by water.	Underside: Not curved; one slight crack visible; pitted in places about 1 in. deep by water.	Underside: Curved downward 1½ in., and bad cracks all over in all directions, mainly longitudinally; much washed off by water.

Fig. 14. THE SEVEN BAYS. DIAGRAM AND TABLE ILLUSTRATING SUMMARY OF TEST.

EXPERIMENTAL FIRE TESTS

CONDUCTED BY THE EXECUTIVE

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899.]

FIRE TEST No. U.A.—OCTOBER 24TH, 1905.

A CEMENT CONCRETE FLOOR

WITH

Bays of Various Aggregates;

THE PORTLAND CEMENT

BEING PROVIDED BY

THE ASSOCIATED PORTLAND CEMENT MANUFACTURERS (1900), LIMITED, LONDON.

OBJECT OF TEST.

To record the effect of a fire of 3 hours' duration, the temperature to reach 1800° Fahr. (982·2 *C.*), but not to exceed 2200° Fahr. (1204·4 *C.*), followed by the application of water for two minutes.

Note.—The area of the floor under investigation was to be divided into seven equal bays of different aggregates, the quantity and quality of Portland Cement used being identical for each bay, and the nature of the concrete used being as follows :—

No.		Parts by volume.
I.	SLAG CONCRETE	Blast furnace slag ... 3 Clean sand ... ... 2 Cement 1
II.	BROKEN BRICK CONCRETE	Broken brick ... 3 Clean sand ... ... 2 Cement 1
III.	GRANITE CONCRETE ...	Broken granite ... 3 Clean sand ... ... 2 Cement 1

No.			Parts by volume.
IV.	Burnt Ballast Concrete	Burnt ballast	5
		Cement	1
V.	Coke Breeze Concrete	Coke breeze	5
		Cement	1
VI.	Clinker Concrete	Furnace clinker	3
		Clean sand	2
		Cement	1
VII.	Thames Ballast Concrete	Thames ballast	3
		Clean sand	2
		Cement	1

The total area of the floor under investigation was to be at least 200 ft. sup. (18·58 □ *m.*).

The soffit of each bay exposed was to be about 10 ft. by 2 ft. 7 in. (3·04 *m.* by ·787 *m.*), the thickness being 5½ ins. (·139 *m.*).

The floor was to be loaded with 224 lb. per ft. sup. (1093·7 6 *kg.* per □ *m.*).

The centring was to be struck 14 days after completion of the floor. The time allowed for drying was 40 days (autumn).

SUMMARY OF EFFECT.

(*See Fig* 14.)

In ten minutes after the gas was lighted the plaster began to fall off the beams and continued to do so until the end of the test.

Towards the end of the test it was observed from the top of the hut that the edges of Bays Nos. I., VI. and VII. were red hot, No. VII. being the worst.

On the application of water more plaster was washed off the beams than had fallen during the fire test, and some of the concrete from the underside of Bays Nos. III., IV., V., VI. and VII., was washed off.

All the slabs remained in position.

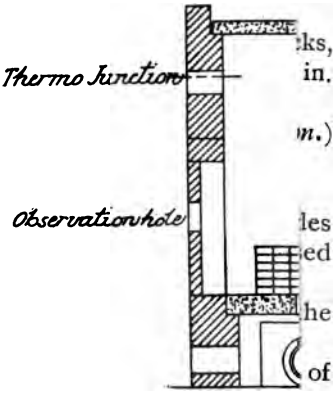
Bay No. VI. was flat on the soffit, all the others were convex on the underside, No. VII. (the worst) to the extent of 1½ in.

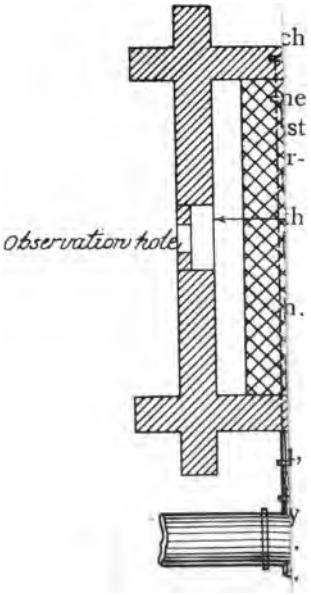
On the removal of the load it was found that bays Nos. I., II., III., VI. and VII. were cracked across, No. VII. being worst.

DESCRIPTION OF TESTING PLANT.

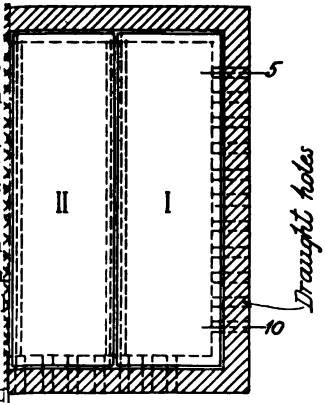
(*See Figs.* 1 *to* 4.)

The testing chamber was located at the Committee's New Testing Station, and was known as "No. 2 Hut."


Thermo Junction
Observation hole


Observation hole

ervation hole



9 & 10 are thermo
couple wires leading to
recording

opp. p. 9

The chamber was constructed as shown of stock bricks, with lime mortar, and measured 10 ft. 2 in. by 22 ft. 4 in. (3·1 *m.* by 6·8 *m.*) internally.

The ceiling of the floor tested was 8 ft. 3 in. (2·514 *m.*) above the pavement of the chamber.

The hut was temporarily covered with tarpaulins.

The door openings on the north, south, and east sides measured 2 ft. by 6 ft. (·61 *m.* by 1·83 *m.*), and were closed up, being filled with brickwork, 4½ in. (·114 *m.*) thick.

The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

The gas was admitted through four mixing chambers of fire-bricks, each 10 ft. by 3 ft. (3·05 *m.* by ·91 *m.*) as shown.

Two Roberts-Austen pyrometers were used for recording temperatures, the first to take a continuous record from point No. 3, and the second to take observations from points 5, 8, 9 and 10.

The load was of bricks distributed on the surface of each bay in separate stacks.

There were four observation holes in the west wall, one in the south wall, one in the north wall, and two in the east wall, the last four being formed in the bricked-up door-openings, each covered with a movable iron shutter.

The draught holes were in the west, north, and south walls.

The photographs were taken by daylight.

Water was applied through two branches, each with ½ in. (·012 *m.*) nozzle, supplied from a small steam fire engine.

CONSTRUCTION OF THE FLOOR.

(*See Figs.* 1 *to* 5.)

The construction of the floor, illustrated in Figs. 1 to 4, was as follows :—

The floor was divided into seven separate bays, each bay being in the clear 10 ft. 2 in. long (3·10 *m.*) by 2 ft. 7 in. (·787 *m.*) wide between the concrete casing of the beams. (*Bays Nos. I. to VII.*)

There were six rolled steel joists each of 6 in. by 4½ in. (·1524 *m.* by ·1143 *m.*), weighing 20 lb. (9·07 *kg.*) per foot

lineal, the ends being built into the side walls of the hut, 1 in. (·025 *m.*) clear space being left at the ends of each joist. Each joist was encased with coke breeze concrete 9 in. wide by 10¾ in. deep (·228 *m.* by ·273 *m.*), so as to give a minimum of 2 in. (·05 *m.*) of concrete all round the joist. (Beams *a*, *b*, *c*, *d*, *e*, *f*.)

The bays or slabs of concrete were 5½ in. thick (·139 *m.*), and were quite separate, resting on a 4½ in. (·114 *m.*) set off all round the walls of the hut and on the concrete casing to the girders, but not fixed thereto, a space being left between each slab.

The cement used was Portland, supplied by the Associated Portland Cement Manufacturers (1900), Ltd., London, and described by them as "Ferrocrete," used as a trade name for this particular brand of cement.

The particulars supplied by the makers contain the following statement:—

(*a*) Very fine grinding—residue on sieve with 32,400 meshes per square inch not exceeding 14 per cent.

(*b*) Great and progressive tensile strength averaging on the inch (6·45 *sq. c. m.*) section:—

	7 days.	28 days.	7 days.	28 days.
Neat cement test ...	550 lb.	750 lb.	249·476 kilos.	340·194 kilos.
Sand test .. .. (3 sand to 1 cement)	200 lb.	350 lb.	90·718 ,,	158·757 ,,

(*c*) Maximum of expansion—not exceeding 2 *m.m.* under the Chatelier test.

The following is a description of the aggregates, giving the amount of aggregate to *one part* by volume of cement in each case.

I. FURNACE SLAG CONCRETE. Bay No. 1 (North Bay). Blast furnace slag from the Islip Ironworks, Thrapston, Northampton, broken to pass a 1½ in. ring (·038 *m.*) *three parts*. Clean pit sand from Kent, *two parts*.

II. BROKEN BRICK CONCRETE. Bay No. 2. Broken brick to pass a 1½ in. ring (·038 *m.*) *three parts* Clean pit sand from Kent, *two parts*.

III. BROKEN GRANITE CONCRETE. Bay No. 3. Broken granite, ¾ in. (·019 *m.*), (Guernsey granite chips), *three parts.* Clean pit sand from Kent, *two parts.*

IV. BURNT BALLAST CONCRETE. Bay No. 4 (Centre Bay). Burnt ballast, viz., clay from the neighbourhood of Child's Hill, burnt with slack coal, broken to pass a 1½ in. (·038 *m.*) ring, *five parts.*

V. COKE BREEZE CONCRETE. Bay No. 5. Coke breeze broken to pass a 1½ in. (·038 *m.*) ring (free from fine dust), from the retorts of a London gas company, *five parts.*

VI. CLINKER CONCRETE. Bay No. 6. Furnace clinker, viz., the raking from the furnaces of large boilers, broken as last, *three parts.* Clean pit sand from Kent, *two parts.*

VII. THAMES BALLAST CONCRETE. Bay No. 7 (South Bay). Thames ballast dredged from the river Thames to pass a 1½ in. ring (·038 *m.*) *three parts.* Clean pit sand from Kent, *two parts.*

Note.—The concrete casing to the girders *a*, *b*, *c*, *d*, *e*, *f*, was all similar to that in Bay No. V., but the coke breeze was finer.

In each case the material was turned both in its dry and wet condition, and the concrete to form each slab laid on the centring in a rather wet state. 1·2 gallons of water were used for each cubic foot of concrete, approximately 20 per cent. of water by volume. Slips of wood were fixed at the sides to retain the concrete in its place and form the necessary spaces.

The joists were fixed in position on September 2nd, 1905. The centering was fixed between 4th and 9th September. The coke breeze casing was put round the joists forming the beams on September 11th.

The slabs or bays were commenced on September 12th and finished on September 14th.

The centring was removed on September 28th.

The coke breeze casing to the beams was rendered with plaster, ¼ in. thick (·006 *m.*), October 3rd to 5th.

PREPARATIONS FOR THE TEST.

During the week ending October 7th, each separate bay was loaded with bricks equal to a distributed load of 224 lb. per ft. super. (1093·7 *kg.* per □ *m.*).

From October 16th to 23rd a coke burner ("devil") was kept alight in the testing chamber.

The covering was finally removed from the roof on October 24th, 1905.

THE TEST.

On October 24th, 1905, the test was undertaken. The following is a log of the test.

At 3 p.m. the meteorological observations taken at the Royal Botanic Gardens, Regent's Park, read as follows: Wind, N.N.E.; Barometer 30·15 in. (·766 *m.*); attached Thermometer 45·5 Fahr. (7·5 *C.*); Dry Bulb 44·0 Fahr. (6·6 *C.*); Wet Bulb 41.2 Fahr. (5.11 *C.*). Remarks: dull, cold day.

The table on page 13 shows the temperature taken from the four pyrometer points, Nos. 5, 8, 9, and 10.

Time p.m.	OBSERVATIONS.	Minutes elapsed.
2 0	The gas was lighted.	
2.10	From this time onwards the plastering fell off the beams in patches continuously throughout the test, but nothing occurred to record with regard to the bays.	10
5.0	The gas was turned off.	180
5.3	Water was applied for three minutes at about 65 lb. pressure (4·42 atmos.) through two branches (one through each of the door openings on the east side) each with a ½-in. nozzle (·012 *m.*) The effect of this was to wash off more of the plastering off the beams, but nothing further could be observed.	183
5.6	The water was turned off.	186

Note.—During the test it was observed that the edges of the slabs Nos. I., VI. and VII. were red hot; this was seen from above in the cavity between the edge of the slabs and the wall.

TEMPERATURES.

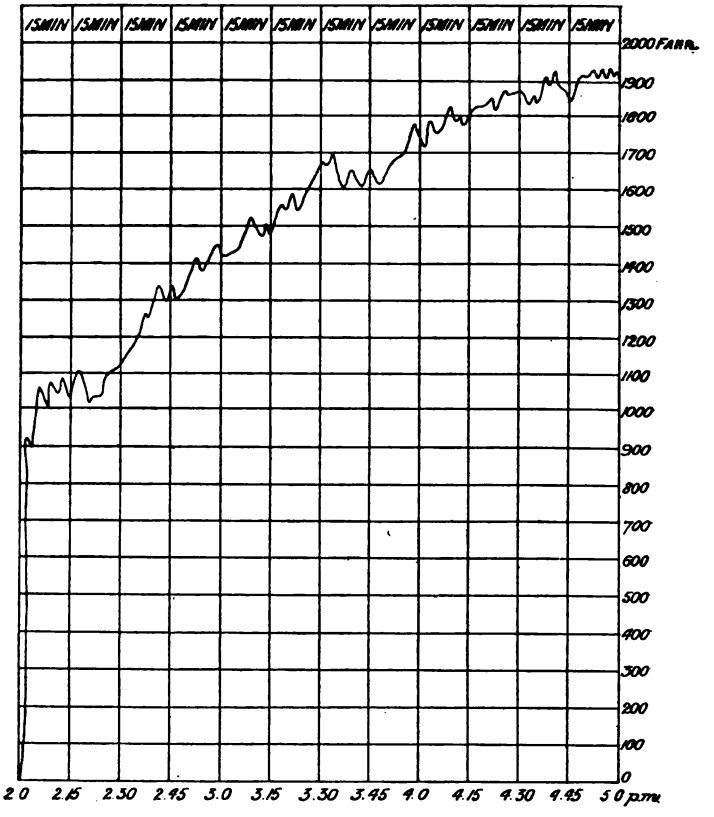
Observations taken from Points Nos. 5, 8, 9. 10.

From 2.0 p.m. to 5.0 p.m.

Time.	No. 5.	No. 8.	No. 9.	No. 10.	Mins. elapsed.
p.m.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	
2.5	900	900	920	840	5
2.10	1020	1010	990	1005	10
2.15	1105	1050	1040	1160	15
	(596·1)	(565·5)	(560 0)	(626 6)	
2 20	1040	1050	1030	1100	20
2.25	950	980	990	1000	25
2.30	1020	1040	1060	1040	30
	(548·8)	(560·0)	(571·1)	(560 0)	
2.35	1050	1100	1150	1100	35
2.40	1180	1220	1210	1200	40
2.45	1200	1310	1320	1280	45
	(548·8)	(710·0)	(715·5)	(693·3)	
2.50	1300	1400	1380	1380	50
2.55	1280	1350	1380	1360	55
3.0	1300	1450	1420	1360	60
	(704·4)	(787·7)	(771·1)	(737·7)	
3.5	1350	1440	1500	1420	65
3.10	1310	1405	1450	1400	70
3.15	1320	1440	1460	1410	75
	(715·5)	(782·2)	(793·3)	(765·5)	
3.20	1360	1450	1500	1440	80
3.25	1420	1540	1520	1500	85
3.30	1420	1560	1600	1550	90
	(771·1)	(848·8)	(871·1)	(843·3)	
3.35	1380	1450	1520	1600	95
3.40	1520	1600	1610	1600	100
3.45	1540	1620	1640	1600	105
	(837·7)	(882·2)	(893·3)	(871·1)	
3.50	1560	1600	1640	1600	110
3.55	1580	1620	1620	1610	115
4.0	1580	1630	1680	1660	120
	(800·0)	(887·7)	(915·5)	(904·4)	
4.5	1560	1600	1670	1700	125
4.10	1610	1700	1740	1720	130
4.15	1680	1720	1780	1760	135
	(915·5)	(937·7)	(971·1)	(960·0)	
4.20	1700	1720	1800	1780	140
4.25	1700	1760	1800	1810	145
4.30	1700	1780	1850	1820	150
	(926·6)	(971·1)	(1010·0)	(993·3)	
4.35	1740	1800	1860	1840	155
4.40	1730	1800	1880	1880	160
4.45	1780	1800	1880	1880	165
	(971·1)	(982·2)	(1026 6)	(1026·6)	
4.50	1760	1840	1900	1900	170
4.55	1780	1850	1900	1910	175
5.0	1780	1850	1910	1920	180
	(971·1)	(1010 0)	(1043 3)	(1048 8)	

Degrees in italics are Centigrade.

The following is the diagram taken from the continuous record of the temperatures at Point No. 3 :—



OBSERVATIONS AFTER TEST.

(*See Figs.* 6 *to* 14.)

On October 27th and 31st the photographs shown in Figs. 6 to 13 were taken.

On October 25th the bricks forming the load were partly removed and the whole were removed on October 26th.

On October 25th observations as to the state of the underside of the beams and slabs were made and on October 27th observations as to the state of top.

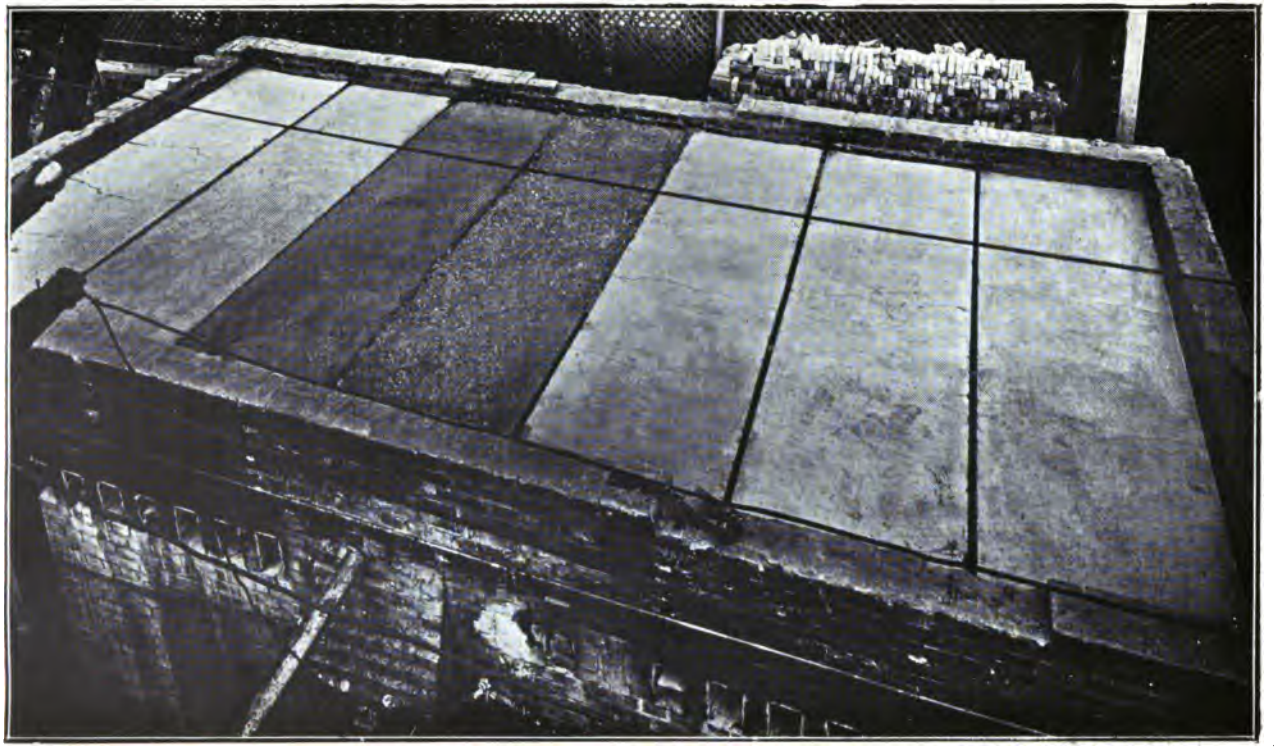


Fig. 6. THE SEVEN BAYS, AFTER THE TEST (SEEN FROM ABOVE).

BAY NO. I. SLAG CONCRETE.

Soffit.—Practically flat on the underside ; slight cracks visible corresponding to those on top.

Top.—Slab cracked across in two places into about three equal parts, curved downwards about $\frac{1}{4}$ in. (·006 *m.*) in the width.

BAY NO. II. BROKEN BRICK CONCRETE.

Soffit.—Curved downwards $\frac{1}{4}$ in. (·006 *m.*) in the centre, in the width ; slight cracks visible corresponding with those on top.

Fig. 7. GENERAL VIEW OF BAYS AFTER TEST (SEEN FROM BELOW).

Top.—Slab cracked across in three places into four rather unequal parts, the west-end portion of the slab being the largest, very slight curve downwards.

BAY NO. III. GRANITE CONCRETE.

Soffit.—Curved downwards $\frac{1}{2}$ in. (·012 *m.*) in the centre, in the width.

About 1 in. (·025 *m.*) washed off the surface in one part and slightly more or less all over the area struck by the water.

Top.—Slab cracked across in three places into four parts, the west-end portion being the largest, curved downwards about ½ in. (·012 *m.*) in the width.

BAY NO. IV. BURNT BALLAST CONCRETE.

Soffit.—Roughly curved downwards about ¼ in. (·006 *m.*) in the centre in the width.

About 3 in. (·076 *m.*) in depth washed off the surface in one part, along the third beam from the North, the greatest depth being about 3 ft. 0 in. (·914 *m.*) from the west side of the hut.

Fig 5. GENERAL VIEW (SHOWING LOAD)

Top.—No cracks—not curved.

BAY NO. V. COKE BREEZE CONCRETE.

Soffit.—Flat on the underside.

About 1 in. (·025 *m.*) washed off the surface generally all over more or less where struck by the water.

Top.—No cracks—not curved.

BAY NO. VI. CLINKER CONCRETE.

Soffit.—Flat on the underside.

Fig. 8. BAYS NOS. VII., VI., V., IV., AFTER TEST (SEEN FROM ABOVE).

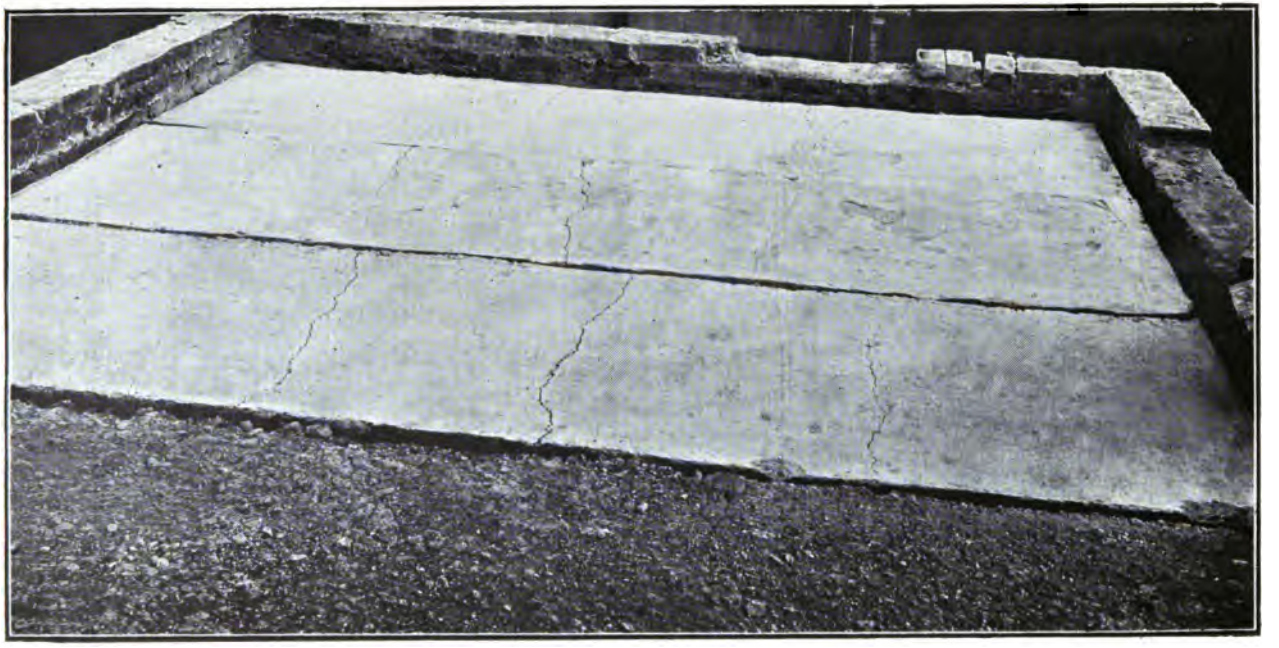


Fig. 9. BAYS NOS. I., II., III., IV., AFTER TEST (SEEN FROM ABOVE).

Surface pitted in places about 1 in. (·025 *m.*) deep where struck by the water and in one place 2 in. (·051 *m.*) deep; one slight crack visible.

Fig. 13. BAY NO. VII., AFTER TEST (SEEN FROM BELOW)

Top.—Slab cracked across in two places into about three equal parts, the west-end portion of the slabs being the largest, curved downward about ⅜ in. (·009 *m.*).

BAY NO. VII. THAMES BALLAST CONCRETE.

Soffit.—Curved downwards 1½ in. (·038 *m.*) in the centre in the width.

Several bad cracks longitudinally in the slabs, extending over almost the whole area, worst about the centre, the cracks being in various irregular directions. Surface damaged all over more than any of the other slabs, greatest depth about 2 in. (·051 *m.*) and a hole in the N.W. corner through which daylight was seen.

Top.—Slab cracked in very many places, cracks being generally transverse or across the slab, but in various diagonal directions as well, no actual longitudinal cracks on upper surface, which are so very marked on the underside, curved downwards about 2 in. (·051 *m.*) in the width.

Beams.—Portions of the plaster remain on all the beams, but it is badly cracked and flaked.

Each beam has part of the concrete washed off where struck by the water. No steel work is exposed. The concrete is disintegrated about 1 in. (·025 *m.*) in depth, on the soffit of each, in patches.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive, for investigations of this description, and was conducted by a Sub-Committee of the Executive, comprising :—

Mr. Max Clarke, F.R.I.B.A. (*Directing Member*).
Mr. B. Dicksee, A.R.I.B.A. (Dist. Surveyor, Stoke Newington).
Mr. J. Herbert Dyer, Vice-President, National Fire Brigades' Union.
Mr. E. J. A. Fulkes (Royal Insurance Co.).
Mr. William Grellier, F.R.I.B.A. (District Surveyor, Clapham).
Mr. Matt. Garbutt, A.R.I.B.A., A.M.Inst.C.E. (Architect to the Metropolitan Ry.).
Mr. A. T. Walmisley, M.Inst.C.E. (Dover Harbour Board).
Mr. Oswald C. Wylson, F.R.I.B.A.
Lieut.-Col. Winn, R.E., A.Inst.C.E.

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Executive was represented for testing operations of October 24th by :—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).
Mr. Ellis Marsland, Dist. Surveyor, Camberwell. (*Gen. Hon. Secretary*).
Mr. Percy Collins.
Mr. J. W. Restler, M.Inst.C.E. (Metropolitan Water Board).
Mr. James Sheppard, A.Inst.E.E. (Surveyor North British and Mercantile Insurance Co.).

The general body of Members was represented for the testing operations of October 24th, 1905, by—

Messrs. Louis T. Healy (Royal Insurance Company); Lieut. S. Sladen (Divisional Officer, London Fire Brigade); H. H. Statham, F.R.I.B.A.; Comandant Welsch (Ghent).

The Commercial Section of "Subscribers" was represented for the testing operations of October 24th, 1905, by—

Messrs. W. H. Aston and W. Sandwell (Messrs. G. Aston and Sons); E. Homan (Messrs. Homan & Rodgers).

Messrs. The Associated Portland Cement Manufacturers (1900), Ltd., were represented by—

Messrs. Harold D. Anderson; H. K. G. Bamber; H. E. Brooks; G. Bartlett; H. J. Joseph; W. E. Ollis; N. Shillito; A. P. Whale.

The following visitors attended at the Testing Station by special invitation of the Executive during the testing operations of October 24th, 1905 :—

Messrs. R. Allison (H.M. Office of Works); V. Brand; C. F. Boreham (H.M. Patent Office); C. McArthur Butler (Secretary Society of Architects); F. A. Baxter; Major A. G. Craven, R.E. (War Office); J. C. Custodis; Edmund Coignet (Paris); A. R. Dyer (Assistant Divisional Officer, London Fire Brigade); H. K. Dyson; J. H. Dales, A.M.Inst.C.E.; Colonel Bagnold, R.E. (H.M. Ordinance Factories, Woolwich); C. H. Freeman; F. A. Hawkins; A. P. Lander; G. A. Lansdowne; F. Morgan; H. W. Monroe (H.M. Patent Office); Chas. H. Mead; Alex. Moir (General Post Office); B. B. Middleton; H. Parsons;

C. H. Reynolds (Crown Agents' Office); T. Sterling: W. Sackfield (H.M. Patent Office); Captain E. N. Stockley, R.E. (War Office); J. C. Stransom's Deputy (Theatres Branch L.C.C.); G. Terrell; W. N. Twelvetrees; Captain C. E. Vickers, R.E. (War Office); F. Walker (Central Electric Supply Company); G. C. Workman; Major J. R. Young, R.E. (Superintendent of Buildings, Woolwich Arsenal) and a representative of the Superintending Architect L.C.C.

Signed,

For the Sub-Committee conducting the Test :—
MAX CLARKE (*Directing Member*).

For the General Testing Arrangements Sub-Committee :—
JAMES SHEPPARD.

For the Executive :—
ELLIS MARSLAND.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—November 27th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—December 2nd, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

POINTS REGARDING THE COMMITTEE.

The British Fire Prevention Committee is now over eight years old, having been founded shortly after the Cripplegate Fire of 1897. Its incorporation dates from 1899.

During this period the Committee has actively pursued its experiments and investigations with ordinary and proprietary building materials and methods of construction, as well as with other inventions intended to prevent the outbreak or spread of fire.

Four series of tests, highly valuable to those who are responsible for the safety of warehouses, shops, factories, or docks, having received special commendation in architectural and engineering circles, viz. :—

Tests with fire-resisting doors ;
Tests with fire-resisting floors ;
Tests with fire-resisting partitions ;
Tests with fire-resisting glazing.

Had the lessons of these tests been more generally studied by the owners of property and their advisers, it is certain that an immense amount of fire loss might already have been avoided. The lessons are, however, now being gradually applied in many directions.

The Committee have prepared "Standards" of Fire Resistance, which have been adopted as Universal Standards throughout Europe.

The Reports on the Committee's tests and its Ordinary Publications are in the form of fully illustrated 8vo "Red Books," of which 100 have already appeared. As soon as each "Red Book" is printed, a copy of it is despatched to every Member and Subscriber, and new Members have the right to any 10 of the preceding numbers without charge, provided that the numbers chosen be not out of print.

The Committee's Quarterly Journal is 4to size, and generally comprises some 50 pages of original matter, frequently profusely illustrated.

One of the most notable events in the history of the Committee was the convocation of the International Fire Prevention Congress, opened by the Right Hon. the Lord Mayor of London, July 6th, 1903, which was attended by 840 members from all parts of the world, including numerous officially appointed representatives from Home, Colonial, and Foreign Governments, municipalities, and public bodies. The valuable papers read thereat by the greatest authorities from all nations have been collected in a handsome volume, which is supplied free to new Members and Subscribers till the edition is exhausted.

At the same time, there was organised under the auspices of the Committee, and opened by H.R.H. the Duke of Cambridge, an International Fire Exhibition, at which the leading British and Continental manufacturers exhibited, and a most interesting Loan Collection was got together, comprising exhibits, and telling in a striking manner the history of fire prevention and fire fighting from the earliest times to the present day.

The International Fire Library, which is being formed by the Committee, already includes over 2,500 items, many of great importance.

For particulars as to Membership or enrolment on the List of Subscribers, apply to the Assistant Secretary, No. 1, Waterloo Place, Pall Mall, London, S.W.

SOUTHWOOD, SMITH & CO., LTD., LONDON, E.C.

"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 102.

Edited by the Executive.

FIRE TESTS WITH PARTITIONS AND WALLS.

A THREE-INCH PARTITION

AND

A NINE-INCH WALL

FORMED OF

ASBESTIC BRICKS,

AND ERECTED BY

THE ASBESTIC BRICK AND TILE COMPANY, LIMITED, LONDON.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897—Incorporated 1899),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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SIR HENRY TRUEMAN WOOD, M.A., Secretary, Society of Arts.

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WATERLOO PLACE, PALL MALL, LONDON, S.W.
(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 7. VIEW OF PARTITION DURING TEST (FROM OUTSIDE).

Fig. 8. VIEW OF PARTITION IMMEDIATELY AFTER TEST (FROM OUTSIDE).

NOTE.

It has been recently proposed to introduce sand bricks as used on the Continent of Europe, and the brick used in the wall and partition now reported upon, known as asbestic brick, is a sand brick with an admixture of asbestic.

From the report presented in respect to the 9-in. brick wall and the partition of brick on edge, it will be seen to what extent this brick can bear comparison with burnt clay bricks when under fire test, followed by the application of water.

SOTH.

J. HERBERT DYER.

LONDON,

September 5th, 1905.

THE GENERAL ARRANGEMENTS FOR TESTS.

(MEMORANDUM.)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

opp. page 6

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TESTS NOS. 61 AND 62.—MARCH 8TH, 1905.

A THREE-INCH PARTITION

AND

A NINE-INCH WALL

FORMED OF

ASBESTIC BRICKS,

AND ERECTED BY

THE ASBESTIC BRICK AND TILE COMPANY, LIMITED, LONDON.

OBJECT OF TEST.

To record the effect of a fire of four hours' duration upon a partition and a wall of asbestic bricks, at a temperature gradually increasing to 1,800° Fahr. (982·2° *C.*), but not exceeding 2,100° (1,148.8° *C.*), followed by the application of water for five minutes on the fire side.

Note.—The area of the partition under investigation was to be at least 80 ft. superficial (7·432 □ *m.*), with a width of 10 ft. (3·048 *m.*).

Note.—The area of the wall under investigation was to be at least 80 ft. superficial (7.432 □ *m.*), with a width of 10 ft. (3·048 *m.*).

Note.—The conditions of this test are those necessary for the classification as "fully protective" (Class B.), under the Standards of Fire Resistance.

Note.—The time allowed for the construction and drying of the partition and wall was two weeks.

SUMMARY OF EFFECT.

THE PARTITION.

In two hours the partition had buckled 5½ in. (·139 *m.*), and in four hours 8⅜ in. (·212 *m.*).

After 40 minutes the temperature on the face of the partition in the passage was 144° Fahr. (62·2° *C.*), and in 120 minutes it was 250° Fahr. (121·1° *C.*).

After 45 minutes the joints commenced to open and crack.

After 80 minutes smoke came through the partition.

After 110 minutes fire came through the partition.

Upon the application of water the partition collapsed.

THE WALL.

In 90 minutes the wall had buckled 1 in. (·025 *m.*),

After 50 minutes the temperature on the outside face of the wall in the open was 65° Fahr. (18·3° *C.*), and in 120 minutes 100° Fahr. (37·7° *C.*).

After 20 minutes the joints commenced to crack.

After 30 minutes the joints commenced to open.

After 50 minutes smoke came through the wall.

After 130 minutes fire came through the wall.

Upon the application of water, about 25 ft. superficial (2·31 □ *m.*) of the wall collapsed.

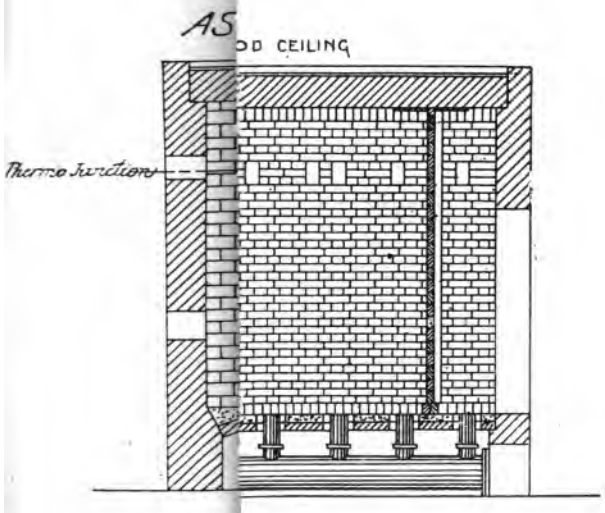
DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The Testing Chamber used was located at the Committee's Testing Station, and was known as "No. 2 Hut."

The hut was constructed as shown of stock bricks, with lime mortar, and measured 22 ft. 3 in. by 10 ft. (6·78 by 3·048 *m.*).

The hut was divided near the centre by a wall of asbestic bricks 9 in. in thickness (·229 *m.*). The floor area of the north side, which contained the partition and wall under test, measured 10 ft. by 10 ft. (3·048 *m.* by 3·048 *m.*), and was covered in with wood baulks 12 in. deep (·304 *m.*), floated on top with lime mortar 1 in. (.025 *m.*) thick, forming a closed chamber the south side remaining open. There



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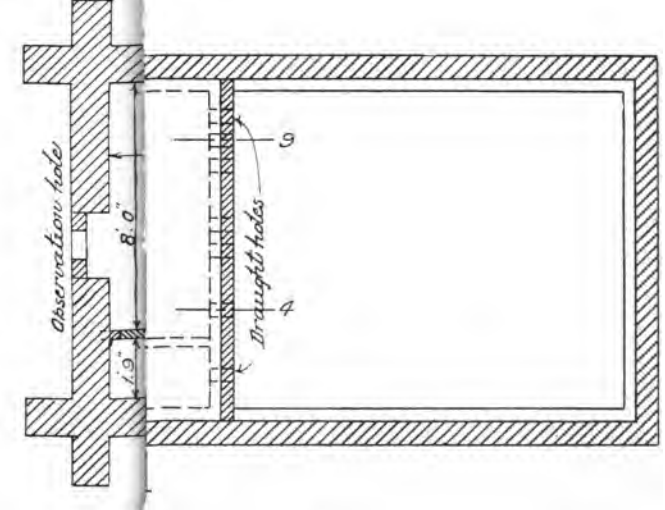

PLAN OF ROOF

opp. page 8

were two door openings on the west side of the hut, each 2 ft. by 6 ft. (·61 by 1·828 *m.*), one to the closed and the other to the open portion of the hut.

The soffit of the baulks was 9 ft. 5 in. (2·87 *m.*) above the pavement of the hut.

The covered portion of the hut was divided as shown on plan, the partition under test being constructed from north to south, the full width and height of the hut leaving the passage on the outside 1 ft. 10 in. (·558 *m.*) wide.

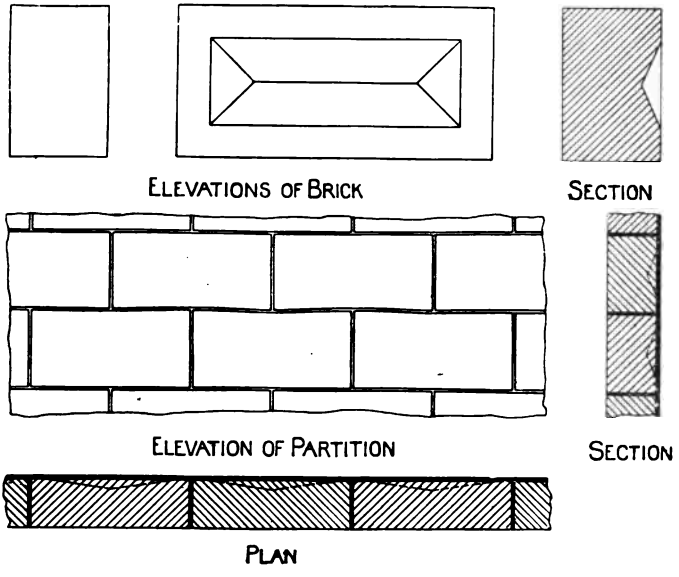

Fig. 5. DETAILS OF THE BRICK AND OF THE PARTITION.

The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

The gas was admitted through two mixing chambers, each 7 ft. 9½ in. by 3 ft. 3 in. (2·374 by ·99 *m.*), as shown.

Two Roberts-Austen pyrometers were used for recording temperatures, one taking a continuous record from point No. 2, and one being used for the observation records at points Nos. 3, 9, 4, 1, 5. Points Nos. 2, 3, 9, 4, were inside

the chamber, and Nos. 1 and 5 outside in the passage. There was one observation hole in the north wall, and two small observation holes in the west wall.

The stream of water was applied to the inside face of partition, through the observation hole on the north side, by a branch with $\frac{3}{4}$ in. (·019 *m.*) nozzle, and supplied from

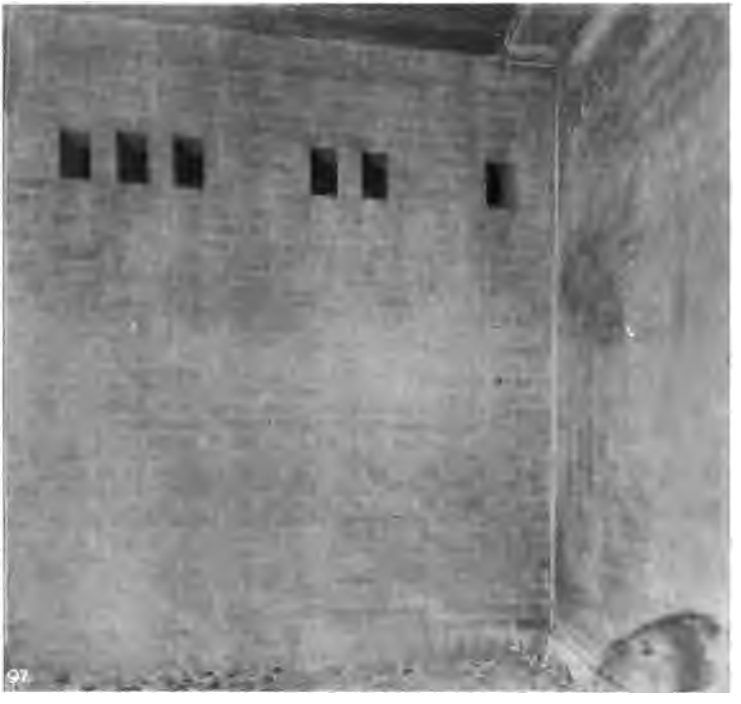

Fig. 6. VIEW OF PARTITION AND WALL BEFORE TEST (FROM INSIDE).

a small steam fire engine, at a pressure of 65 lb. to the square inch (4·42 *atms.*).

CONSTRUCTION OF THE PARTITION AND WALL.

(*See Figs.* 1 *to* 6.)

Plans, elevations, and sections of the partition and wall are shown.

On February 24th to 28th the partition and wall were erected.

THE PARTITION.

The bricks forming the partition were built on the floor of the hut, and carried up to the underside of the wood ceiling, the height of the partition was 9 ft. 5 in. (2·87 *m.*). The partition was 3 in. thick (·076 *m.*), built of bricks 9 in. (·228 *m.*) by $4\frac{3}{8}$ in. (·111 *m.*) by $2\frac{5}{8}$ in. (·066 *m.*) thick.

The bricks had a frog on the face towards the fire. (*See Fig.* 5.)

The partition was built of asbestic bricks on edge, there being 25 courses resting upon a course of footing bricks; the mortar joints average $\frac{5}{16}$ in. thick (·008 *m.*). The outside face of the bricks was neatly pointed and the inside was plastered with asbestic plaster $\frac{3}{8}$ in. thick (·009 *m.*). The partition was bonded into the sides.

The mortar used was said by the maker to consist of lime and sand.

THE WALL.

The wall was built of similar bricks to those forming the partition, and was 9 in. (·228 *m.*) thick, the bond being English bond, and set in mortar similar to the partition.

The wall was bonded into the east and west walls of the chamber.

The four top courses of the wall above the level of the ceiling were in $4\frac{1}{2}$-in. work.

On February 24th, two coke fires were lighted in the hut, and kept burning about ten hours a day until March 7th, when they were removed.

THE TEST.

(*See Figs. 7 to* 11.)

On March 8th, 1905, the test was undertaken. The following is a log of the test :—

At 9 a.m. the meteorological observations, taken at the Botanic Gardens, Regent's Park, read as follows :—

"State of weather, cloudy; Wind, W.S.W.; Barometer, 30·13 in. (0·795 *m.*); Wet Bulb, 36·5° Fahr. (2·45 *C.*); Dry Bulb, 39·5° Fahr. (4·1 *C.*). Remarks: Fine morning, cold wind."

THE PARTITION. NOTES ON THE OUTSIDE.		Minutes elapsed.
10.30 a.m.	Gas lighted.	
10.40 a.m.	Top joints showing steam.	10
11.0 a.m.	Steam increasing. Partition commencing to bulge in the direction of the fire.	30
11.10 a.m.	Passage full of steam.	40
11.15 a.m.	First horizontal joint above footing course beginning to crack.	45
11.30 a.m.	Cracks starting on the third course in centre and extending upwards to the right and left.	60
11.40 a.m.	Joints opening out, more especially on the north side at bottom.	70
11.50 a.m.	Horizontal crack above footing increasing and smoke coming through.	80
12 noon.	Black smoke coming through joints at upper south corner, especially through No. 19 joint, and through the vertical joints in courses Nos. 12, 13, 14, and 15.	90

NOTES ON THE OUTSIDE—*continued*.		Minutes elapsed.
12.20 p.m.	Fillet cracked at north end; fire coming through vertical cracks in places.	110
12.40 p.m.	Fire and smoke coming through vertical joints in courses Nos. 12 to 20.	130
12.50 p.m.	Cracks appearing on fourth course and bricks beginning to shear off the course immediately below them.	140
1.20 p.m.	The various cracks had increased in width, and after this very little change occurred till nearly the end of the test.	170
2.30 p.m.	Numerous cross joints open with flames coming through.	240
2.31 p.m.	Water was turned on to the inside face of the partition at a pressure of about 65 lb. to the square inch (4·42 *atms.*), for five minutes. The effect was that about two-thirds of the partition collapsed immediately water was applied.	241
	NOTES ON THE INSIDE.	
11.30 a.m.	The face of the plastering began to show hair cracks, which developed during the test in the direction of the joints of the bricks as the partition bulged inwards.	60
1.2 p.m.	There was a patch of plaster about 9 in. (·2286 *m.*) diameter in centre of partition detached from the face of the bricks, but held in position at top.	152

THE WALL.

NOTES ON THE OUTSIDE.

		Minutes elapsed.
10.50 a.m.	Horizontal cracks appeared about twelve courses below vent holes.	20
11.0 a.m.	Steam and smoke coming through cracks.	30
11.10 a.m.	Parapet wall beginning to crack, the cracks extending nearly to floor level.	40
11.20 a.m.	Numerous joints opening. Steam coming through joints, and wall commencing to bulge.	50
11.30 a.m.	Steam coming through joints and bulging of wall increasing	60
11.35 a.m.	Steam coming through joints all along for three or four courses below vent holes. Filleting against east wall opened about ¼ in. (·006 *m.*).	65
11.45 a.m.	Cracks open about ¼ in. (·006 *m.*). Steam coming through joints over entire face. Brickwork above vent holes much cracked.	75
12.10 p.m.	All cracks opening more and steam coming through freely.	100
12.40 p.m.	Flames coming through at back of fillets on east side.	130
1.15 p.m.	A considerable quantity of smoke issuing from west corner.	165
2.25 p.m.	Steam continuing to issue from joints. Flames continuing to issue from behind upper part of fillet on west side.	235
2.30 p.m.	Gas turned off.	240
2.31 p.m.	Upon water being applied for five minutes, a considerable portion of the wall collapsed, and bricks were moved from their beds in the portion of the wall that did not collapse.	241

Observations taken from Points Nos. 1, 3, 4, 5, 9.
From 10.30 *a.m. to* 2.30 *p.m.*

	Inside.			Outside in Passage.		
Time.	No. 3.	No. 9.	No. 4.	No. 1.	No. 5.	Minutes Elapsed.
a.m.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	
10.35	1150	1050	1100	—	—	5
10.40	1050	1050	1050	—	—	10
10.40	1080	1050	1060	—	—	15
	(582·2)	(565·5)	(571·1)			
10.50	1350	1280	1300	—	—	20
10.55	1420	1400	1400	—	—	25
11.0	1480	1450	1450	—	—	30
	(804·4)	(787·7)	(787·7)			
1.5	1520	1500	1480	—	—	35
11.10	1550	1550	1550	—	—	40
11.15	1500	1500	1500	—	—	45
	(815·5)	(815·5)	(815·5)			
11.20	1600	1550	1580	—	120	50
11.25	1520	1620	1650	160	170	55
11.30	1540	1650	1680	180	180	60
	(837·7)	(898·8)	(915·5)	(82·2)	(82·2)	
11,35	1620	1720	1680	200	180	65
11.40	1640	1750	1700	180	180	70
11.45	1680	1800	1740	180	180	75
	(915·5)	(982·2)	(948·8)	(82·2)	(82·2)	
11.50	1680	1820	1780	180	200	80
11.55	1650	1740	1750	200	205	85
12.0	1700	1820	1800	205	210	90
	(926·6)	(993·3)	(982·2)	(96·1)	(98·8)	
p.m.						
12.5	1640	1760	1780	210	215	95
12.10	1620	1800	1780	210	220	100
12.15	1620	1820	1800	220	225	105
	(882·2)	(993·3)	(982·2)	(104·4)	(107·2)	
12.20	1920	1900	1880	240	240	110
12.25	1980	1980	1960	280	280	115
12.30	2005	2010	1975	250	260	120
	(1096·1)	(1098·8)	(1079·4)	(121·1)	(126·6)	
12.35	1900	1910	1940	250	260	125
12.40	1910	1880	1900	300	305	130
12.45	2000	1980	1900	310	315	135
	(1093·3)	(1082·2)	(1037·7)	(154·4)	(157·2)	
12.50	1980	1940	1960	350	380	140
12.55	1980	1940	1960	400	405	145
1.0	2000	1960	1980	410	420	150
	(1093·3)	(1071·1)	(1082·2)	(210·0)	(215·5)	
1.5	2020	2000	2000	450	475	155
1.10	1840	1840	1840	450	480	160
1.15	1840	1860	1820	480	510	165
	(1004·4)	(1015·5)	(993·3)	(248·8)	(265·5)	
1.20	1930	1980	1900	540	580	170
1.25	1880	1880	1820	550	620	175
1.30	1900	1910	1880	560	610	180
	(1037·7)	(1043·3)	(1026·6)	(293·3)	(321·1)	
1.35	1900	1900	1860	600	650	185
1.40	1910	1950	1900	620	680	190
1.45	1920	1940	1900	630	710	195
	(1048·8)	(1060·0)	(1037·7)	(332·2)	(376·6)	
1.50	1910	1940	1860	650	750	200
1.55	1950	1940	1900	680	750	205
2.0	1905	1940	1900	680	795	210
	(1040·5)	(1060·0)	(1037·7)	(360·0)	(423·8)	
2.5	1900	1900	1860	690	810	215
2·10	1900	1900	1840	720	830	220
2.15	1920	1940	1900	720	850	225
	(1048·8)	(1060·0)	(1037·7)	(382·2)	(454·4)	
2.20	1980	1990	1960	760	875	230
2.25	2020	2020	2000	790	880	235
2.30	2020	2000	1960	805	845	240
	(1104·4)	(1093·3)	(1071·1)	(429·4)	(451·6)	

* Degrees in Italics are Centigrade.

The Continuous Record No. 2 failed.

THE PARTITION.

Table showing the temperature on the face of the partition on passage side during the test; also the bulging of the partition towards the fire :—

TIME.	FAHR.	CENT.	INCHES.	METRES.	MINUTES ELAPSED.
11.10 a.m.	144·0	(62·2)	—	—	—
11.20 a.m.	130·0	(54·4)	1½	(·0380)	50
11.40 a.m.	145·0	(62·7)	2⅝	(·0666)	70
11.50 a.m.	—	—	3⅛	(·0793)	80
12.0 noon	205·0	(96·1)	4	(·1016)	90
12.20 p.m.	220·0	(104·4)	4¾	(·1206)	110
12.30 p.m.	250·0	(121·1)	5½	(·1397)	120
12.40 p.m.			6¼	(·1587)	130
1.10 p.m.	Thermometer		7⅛	(·1809)	160
1.30 p.m.	removed.		7¾	(·1968)	180
2.15 p.m.			8¼	(·2095)	225
2.30 p.m.			8⅜	(·2127)	240

THE WALL.

Table showing the temperature on the outside face and the bulging :—

TIME.	FAHR.	CENT.	INCHES.	METRES.	MINUTES ELAPSED.
11.20 a.m.	65	(18·3)	½	(·0127)	50
11.45 a.m.	72	(22·2)	¾	(·0190)	75
12.0 noon	90	(32·2)	1	(·0254)	90
12.10 p.m.	98	(36·6)	—	—	100
12.20 p.m.	95	(35·0)	1	(·0254)	110
12.30 p.m.	100	(37·7)	—	—	120
12.55 p.m.	100	(37·7)	1	(·0254)	145
1.15 p.m.	82	(27·7)	—	—	165
1.20 p.m.	90	(32·2)	1	(·0254)	170
2.25 p.m.	85	(29·4)	1	(·0254)	235

OBSERVATIONS AFTER TEST.

(*Figs.* 10 *and* 11.)

On March 11th, 1905, the following observations were made:—

THE PARTITION.

Outside.—About 60 ft. (5·58 □ *m.*) of the partition had fallen leaving the remainder in an insecure condition.

The outside face of the bricks, remaining in position, showed no effects of the fire.

Inside.—The face of the bricks on the fire side, where not struck by the jet, was discoloured and friable on the surface.

The face of the bricks, where struck by the jet, was eroded to a depth of an average of 1 in. (·025 *m.*).

THE WALL.

Outside.—About 25 feet (2·31 □ *m.*) superficial of the wall had fallen, leaving the remainder in a cracked and insecure condition.

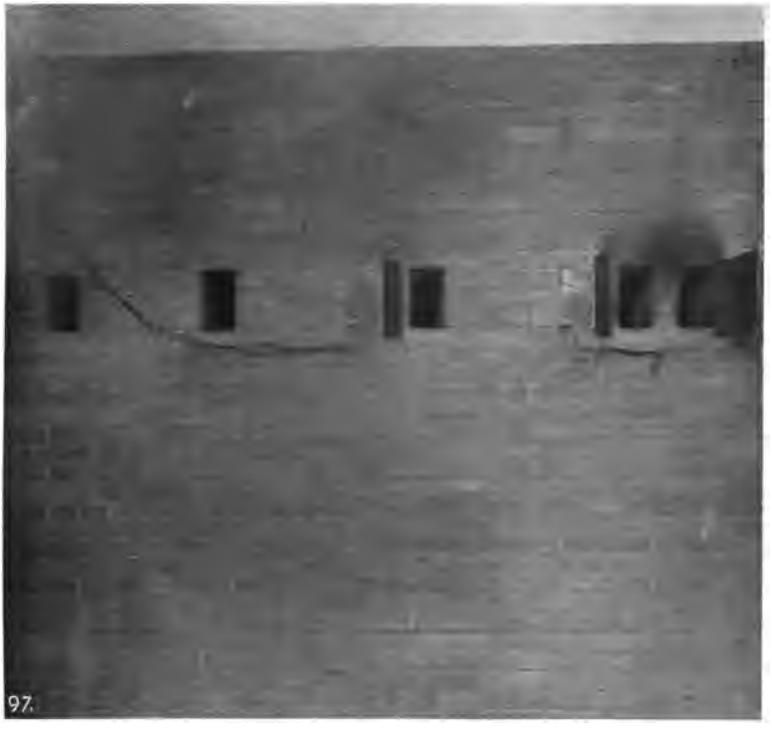

Fig. 9. VIEW OF WALL (FROM OUTSIDE) DURING TEST, AFTER 60 MINUTES.

The outside face of the bricks forming the portion of wall remaining in position showed no effects of fire.

Inside.—The face of the bricks on the fire side, where not struck by the jet was discoloured and friable on the surface.

The face of the bricks where struck by the jet, was eroded to an average depth of about 1 in. (·025) and many of the bricks were loose and displaced from their beds.

Fig. 10. View of Wall after Test (from outside).

GENERAL ARRANGEMENTS.

The Test was carried out according to the procedure laid down by the Executive for investigations of this description, and conducted by a Sub-Committee of the Executive comprising :—

Mr. J. H. Dyer (Vice-President National Fire Brigade Union), Directing Member.
Mr. Ellis Marsland (District Surveyor, Camberwell).
Mr. Wm. Grellier, F.R.I.B.A. (District Surveyor, Clapham).
Mr. H. C. Carter, C.E. (*Visitor*).

Mr. A. H. Lister assisted the Sub-Committee.
Mr. H. B. White, M.Inst.E.E. superintended in the Instrument Room.

The Council was represented by—

Mr. H. H. Collins, F.R.I.B.A. (District Surveyor, Eastern Division, City of London).

The Executive was represented by :—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).
Mr. Ellis H. Pritchett, F.R.I.B.A., F.S.I. [the late].
Mr. Max Clarke, F.R.I.B.A.
Mr. James Sheppard, A.Inst.E.E. (Surveyor North British and Mercantile Insurance Co.).
Mr. E. de Segundo, A.M.Inst.C.E., M.I.Mech.E.

The General Body of Members was represented by—

Lieut.-Col. W. George Dixon, V.D. (Vice-Pres. Nat. Fire Brigade Union) [the late] ; Messrs. E. J. A. Fulkes (Royal Insurance Co.) ; Matt. Garbutt, A.R.I.B.A. (Surveyor Metropolitan Railway Co.) ; F. W. Hamilton, A.R.I.B.A. (District Surveyor, North Fulham) ; R. P. Notley, F.R.I.B.A. (District Surveyor, Bethnal Green) ; Frank B. Passmore, M.Inst.M.E., J. J. Thomas (Chief Super. Liverpool Fire Brigade).

Messrs. Asbestic Brick and Tile Co. were represented by—

Messrs. Wm. Bloore, J. A. Draper, A. Gourd, T. Holloway, A. E. Hansen, and J. Sabey.

The following visitors attended at the Testing Station by special invitation of the Executive during the testing operations of March 8th :—

Messrs. The Danish Consul-General (J. Faber); J. Gavey, C.B., M.Inst.C.E., Engineer-in-Chief; W. Brown and W. Alex. Moir, of the General Post Office; Chief Officer Captain Hamilton, R.N., Divisional Officer Sidney Gamble, F.S.I., and Divisional Officer Lieut. Sladen, R.N., of the London Fire Brigade; A. C. Booth; H. F. Dale; H. K. Dyson; H. A. McFarren (Asst. Engineer, H.M. Office of Works); E. Henius (Copenhagen); Arthur B. Hayward; Wm. de Jongh; — Jackson; J. Lassen; N. G. Pennington; J. Pulleine; J. Redgrave (H.M. Superintending Inspector of Factories, Home Office); W. A. Rees (Liv., Lond. and Globe Insurance Co.); H. Rallings; George Stubbings (Supt. of Fire Brigade Great Eastern Railway); J. W. Ward; Hugh P. Whall; and R. Young.

(Signed) *For the Sub-Committee conducting the Test :*

J. HERBERT DYER, *Directing Member.*

For the General Testing Arrangements Sub-Committee :

ELLIS MARSLAND.

For the Executive :

JAMES SHEPPARD.

Published by the Committee as directed by the Executive.

C. F. ADAMI,
Asst. Secretary.

Date—September 5th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE-INNES, SON AND CRICK, *Solicitors.*

Date—September 5th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

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"*RED BOOKS*" *of the*

BRITISH FIRE PREVENTION COMMITTEE.—No. 103.

Edited by the Executive.

FIRE TESTS WITH FLOORS.

A FLOOR

CONSTRUCTED ON

THE BREMER SYSTEM

BY

MESSRS. R. FABER,

BERLIN.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(*Founded 1897—Incorporated 1899*),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 10. THE FLOOR, VIEW AFTER TEST (FROM BELOW, LOOKING SOUTH).

NOTE.

This test is of unusual interest, as it is the first test made by the Committee with a girderless fire-resisting floor constructed of "semi-porous" terra-cotta blocks with a reinforcement of metal rods over an area of 22 ft. by 10 ft.

ELLIS MARSLAND.

LONDON, S.W.,
September 20th, 1905.

SOTHERAN

THE GENERAL ARRANGEMENTS FOR TESTS.

(MEMORANDUM.)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST No. 71.—AUGUST 16TH, 1905.

A FLOOR

CONSTRUCTED ON

THE BREMER SYSTEM

BY

MESSRS. R. FABER,

BERLIN.

OBJECT OF TEST.

To record the effect of a fire of two and a-half hours' duration, the temperature to reach 1800° Fahr. (982·2 *C.*), but not to exceed 2200° Fahr. (1204·4 *C.*), followed by the application of water for two minutes, with a view to classification under "Full Protection" (Class A).

Note.—The area of the floor under investigation was to be at least 200 ft. sup. (18·58□*m.*). The floor was to be loaded with 224 lb. per square foot (1093·7 *kgs.* per □*m.*) distributed.

The time allowed for drying the floor was thirty-five days (summer).

SUMMARY OF EFFECT.

In one minute after the gas was lighted the plaster began to fall and continued to do so till the end of the test.

On the application of water the plaster to the soffit was washed off where struck by the jet and some of the longitudinal joints were washed out, exposing the iron rods.

The floor remained in position.

The maximum deflection of the floor was 3 in. (·076 *m.*).

Neither fire nor water passed through the floor.

On the removal of the load the upper surface of the floor showed one longitudinal and nine transverse cracks and four diagonal cracks at the corners.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The testing chamber was located at the Committee's New Testing Station, and was known as "No. 2 Hut."

The chamber was constructed as shown, of stock bricks, with lime mortar, and measured 10 ft. by 22 ft. 3 in. (3·05 *m.* by 6·78 *m.*) internally.

The ceiling of the floor tested was 8 ft. 3 in. (2·51 *m.*), above the pavement of the chamber.

The hut was temporarily covered with tarpaulins.

The door-openings on the north, south, and east sides measured 2 ft. by 6 ft. (·61 *m.* by 1·83 *m.*), and were closed by being filled in with brickwork, 4½ in. (·114 *m.*) thick.

The fuel used was gas produced at the station, and the supply was regulated by valves and dampers.

The gas was admitted through four mixing chambers of fire-bricks each 10 ft. by 3 ft. (3·05 *m.* by ·91 *m.*), as shown.

Two Roberts-Austen pyrometers were used for recording temperatures, the first to take a continuous record from point No. 2, and the second to take observations from points Nos. 5, 8, 9, and 10.

The load was of bricks, distributed on the surface of the floor in three piles (*see* Fig. 8).

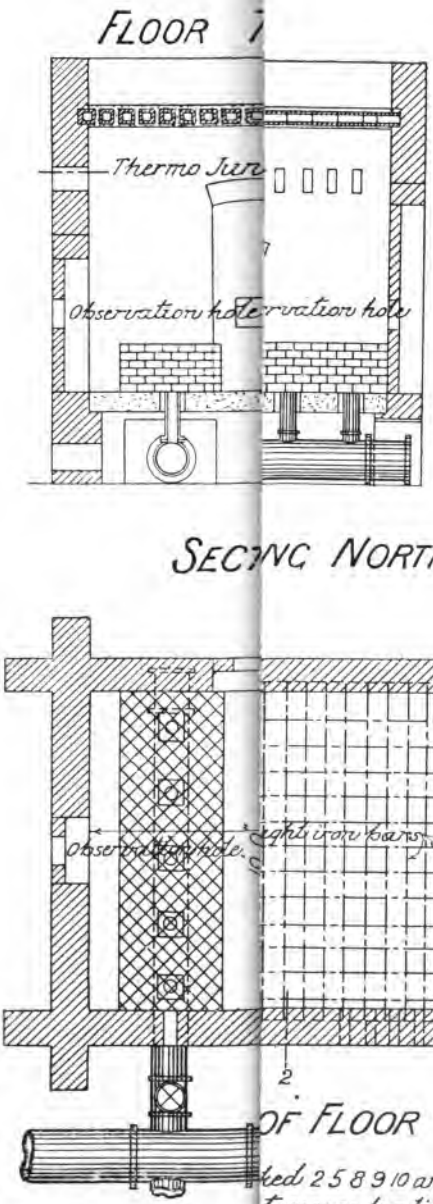
There were four observation holes in the west wall, one in the south wall, one in the north wall, and two in the east wall, the last four being formed in the bricked-up door-openings, each covered with a movable iron shutter.

The draught holes were in the west, north, and south walls.

The photographs were taken by daylight and by flashlight.

Water was applied through a branch with ¾ in. (·02 *m.*) nozzle supplied from a small steam fire engine.

The deflections of the floor were taken by a level placed on the roof of an adjoining hut, and wooden staffs were placed


FLOOR
Thermo Junc
Observation hole
Observation hole
SECTNG NORTH
Observation hole
Light iron bars
Draught holes
OF FLOOR
ked 2 5 8 9 10 are thermo junctions
to wires leading to Pyrometers
recording

)W, SHOWING IRON RODS EXPOSED). *opp. page* 9.

on floor where shown, the readings being every five minutes during the test.

CONSTRUCTION OF THE FLOOR.

(*See Figs.* 1 *to* 7.)

The construction of the floor, illustrated in Figs. 1 to 7, was as follows :—

On July 8th, 1905, wood centering was placed in the hut at a level of 8 ft. 3 in. (2·51 *m.*) above the floor of the chamber.

Fig. 7. VIEW SHOWING BLOCKS IN POSITION ON CENTREING.

On July the 11th and 12th the floor was constructed on the centering, as follows :—

The blocks forming the floor were hollow, and were composed of semi-porous terra cotta 9¾ in. by 6 in. by 6 in. (·25 *m.* by ·15 *m.* by ·15 *m.*), and the thickness of the walls of the blocks was about 1½ in. (·04 *m.*), one end of each block was pared down on three sides to admit of iron rods being passed between, and one face of each block had two semi-circular grooves on the sides for the same purpose. (*See detail.*)

These blocks were laid on the centreing and set with cement and sand 1 to 3, with a bearing on the walls of $4\frac{1}{2}$ in. (·11 *m.*). (*See* Fig. 7.)

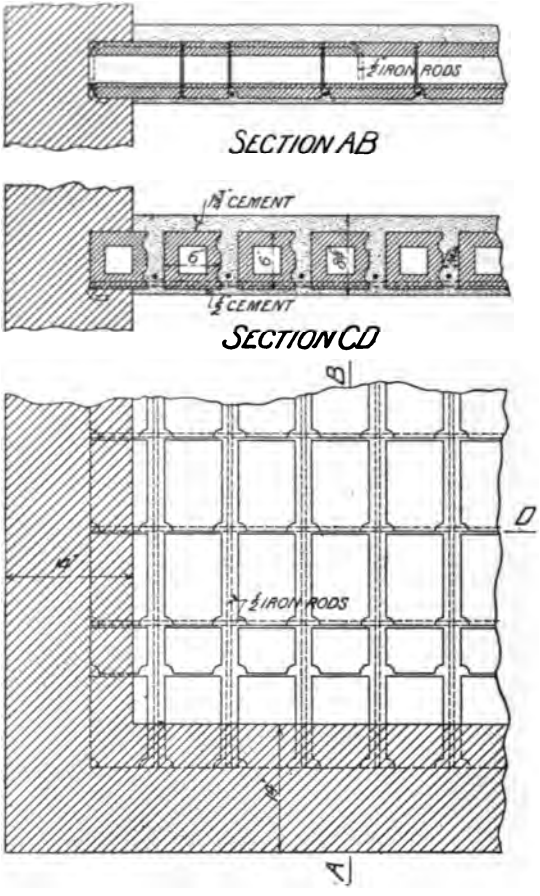
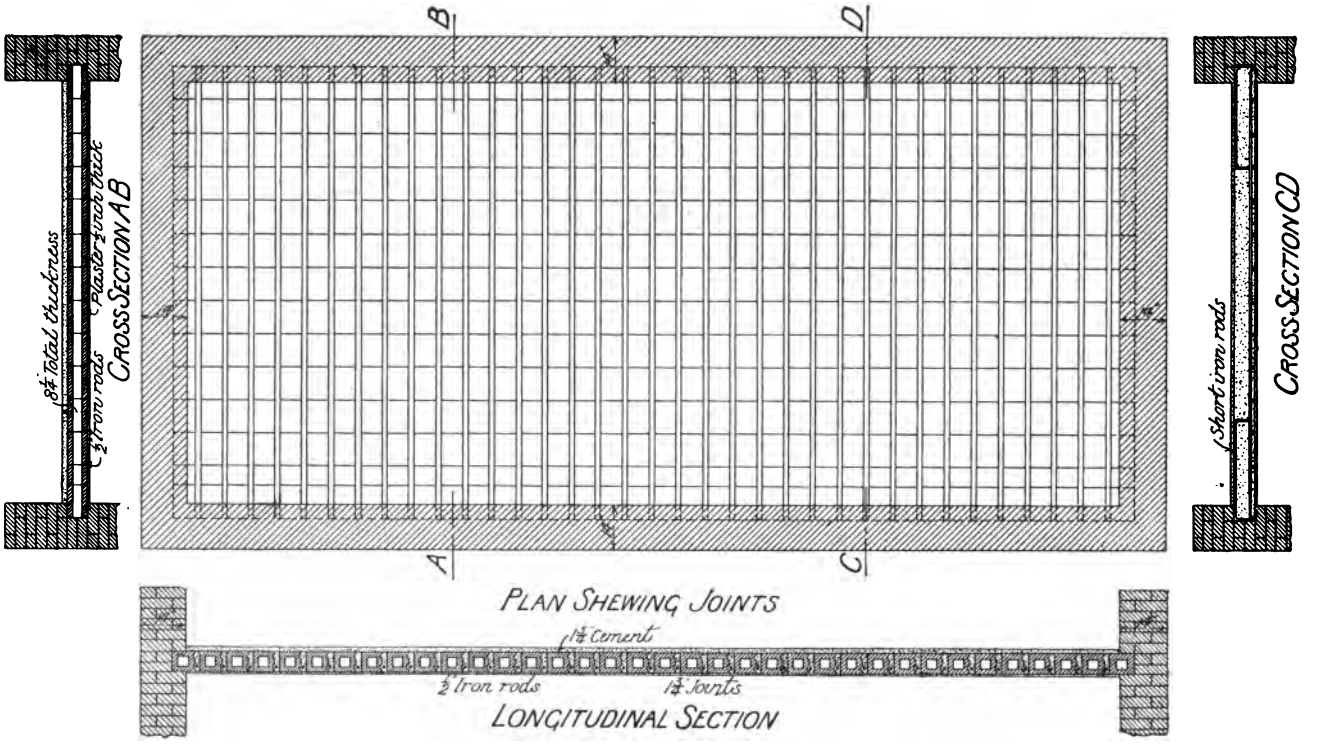


Fig. 5. DETAILS OF THE FLOOR.

Between each block longitudinally, and within about 1 in. (·025 *m.*) from the bottom of the blocks, wrought-iron bars were fixed, ½ in. (·01 *m.*) diameter, having a bearing on the



Figs. 6 and 7. THE FLOOR, PLAN AND SECTIONS.

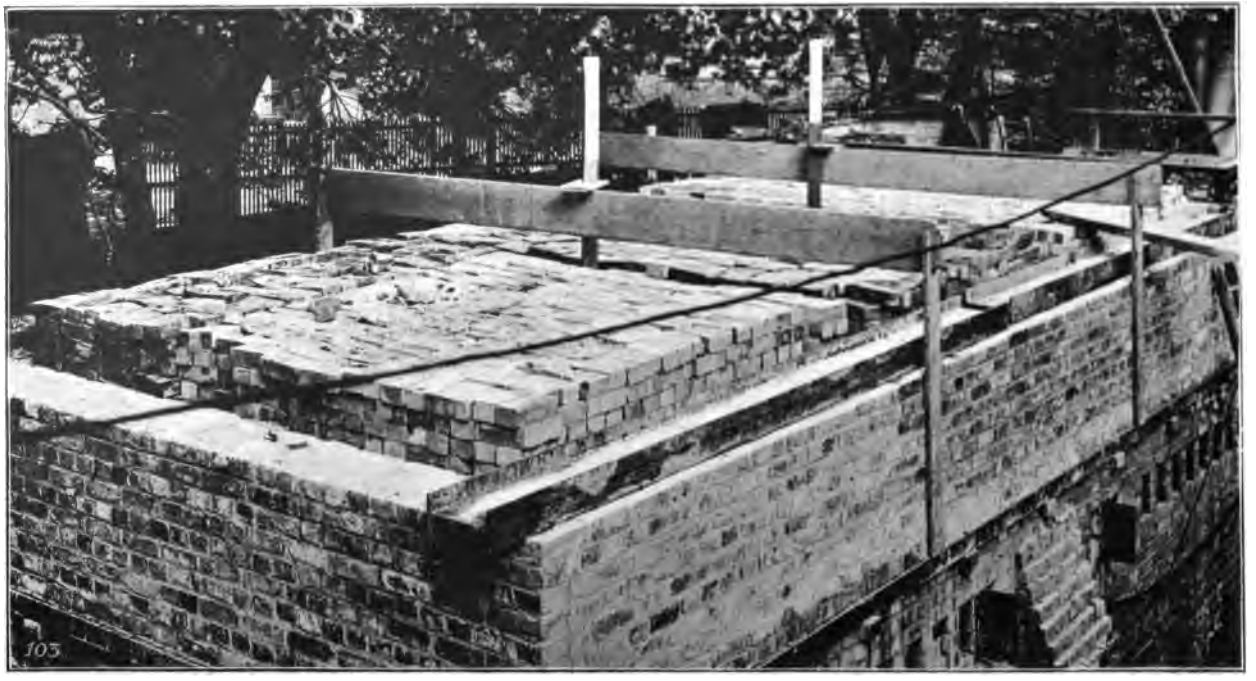


Fig. 8. THE FLOOR, VIEW BEFORE TEST, SHOWING LOAD (FROM ABOVE).

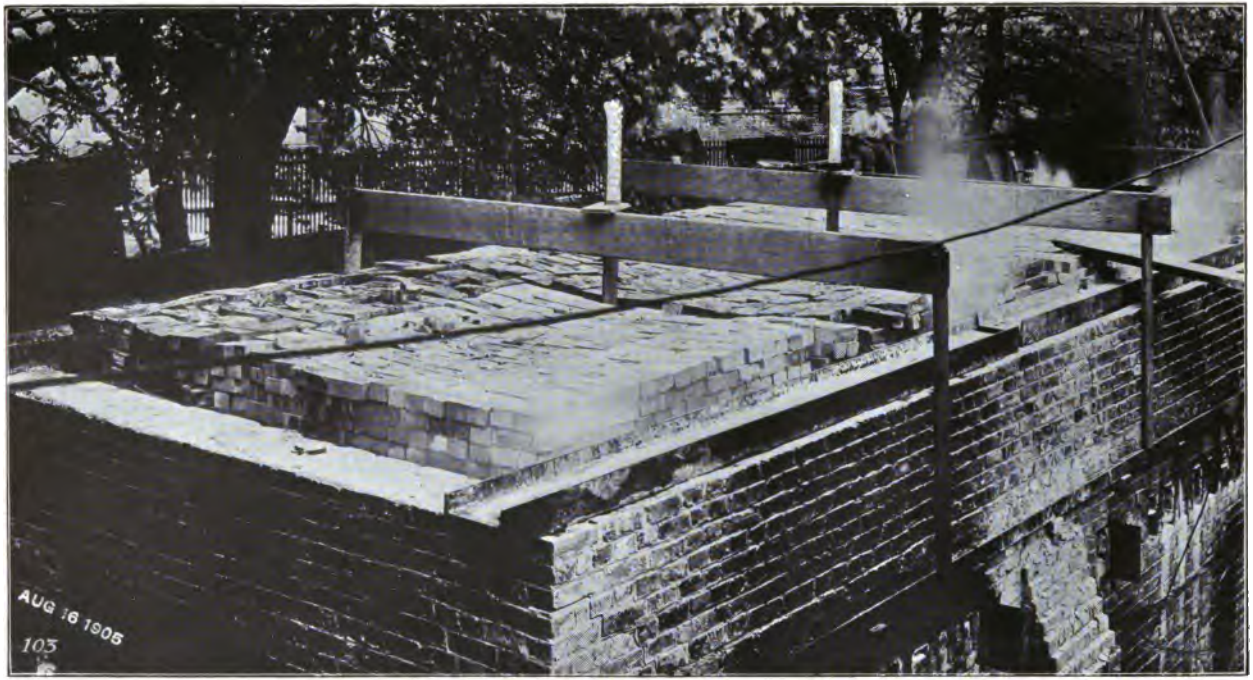


Fig. 9. THE FLOOR, VIEW AFTER TEST (FROM ABOVE).

north and south walls of the hut of 4½ in. (·11 *m.*), and with hooked ends. These longitudinal bars were in two lengths and hooked in the centre. Above these longitudinal bars transversely other wrought-iron bars of the same diameter were fixed between the blocks, with the ends hooked and resting 4½ in. (·11 *m.*) in the east and west walls of the hut.

The cement joints between the blocks transversely were about 1¾ in. (·04 *m.*) wide. Those longitudinally were as closely butted as the irregularities in the blocks would permit.

After the blocks were fixed short iron rods about 2 ft. 5 in. long (·74 *m.*), and with ends turned down 4 in. (·10 *m.*), were pressed down on the top of the blocks, 21 on one side and 24 on the other, while the mortar was soft on the east and west sides of the floor between the transverse joints extending from the edge of the floor inwards.

The top of the floor was coated with cement rendering in the proportion of one of cement to two of sand to an average thickness of 1¾ in. (·04 *m.*).

On August 4th the soffit of the floor was plastered in two coats with plaster composed of grey lime and sand in the proportion of 1 to 2, to which was added a small proportion of asbestic and hair.

The thickness of the plastering being about ½ in (·01 *m.*).

The total thickness of the floor was about 8¼ in. (·21 *m.*)

After the floor was finished the top of the floor was kept moist with water for about ten days.

PREPARATIONS FOR TEST.

During the week preceding the tests the floor was loaded with stock bricks equal to a distributed load of 224 lb. per square foot (1093·7 *kg.* per □ *m.*).

On the top of the parapet of the east, north, and west walls lengths of rolled steel joists 10 in. by 5 in. were placed. (*See* Fig. 8.)

The tarpaulins were finally removed on the morning of the 16th August, before the test began.

THE TEST.

On August 16th, 1905, the test was undertaken. The following is a log of the test :—

At 3 p.m. the meteorological observations taken at the Botanic Gardens, Regent's Park, read as follows :—

"State of weather, cloudy; Wind, E.S.E.; Barometer, 30·06 inches; Attached Thermometer, 67° Fahr. (19·4 *C.*; dry Bulb, 69·5° Fahr. (20·7 *C.*); wet Bulb, 60° Fahr. (15·5 *C.*); Remarks: Fine day."

The table on p. 16 shows the temperatures taken from the four pyrometer observation points in the hut, shown on Figs. 1 to 4 as Nos. 5, 8, 9, 10.

TIME p.m.	OBSERVATIONS.	Minutes Elapsed.
4.0	The gas was lighted.	
4.1	The setting coat of the plastering to the ceiling commenced to fall off for about half the area at the south end.	1
4.2	The same occurred at the north end.	2
4.5	The second coat of the plastering commenced to come off in circular patches, exposing the soffit of the terra-cotta blocks.	5
4.25	The plastering still falling in patches.	25
5.0	Hair cracks appeared in joints between blocks.	60
6.15	A longitudinal crack appeared along the centre of floor for about two-thirds the length.	135
6.30	The gas was turned off.	150
6.34	Water was applied for two minutes at about 65 lb. pressure (4·42 *atmos.*) through a branch with a ¾ in. (·02 *m.*) nozzle. The effect of this was to wash away the remaining portions of the plastering from the soffit of the floor where struck by the jet and also some of the longitudinal cement joints, exposing the iron rods	154
6.36	The water was turned off. The fire and water had not passed through the floor.	156

TEMPERATURES AND DEFLECTIONS.

TEMPERATURES TAKEN AT POINTS NOS. 5, 8, 9, 10.
DEFLECTIONS TAKEN AT POINTS A AND B.

From 4 p.m. to 6.30 p.m.

Time.	No. 5.	No. 8.	No. 9.	No. 10.	Point A. Inch.	Point B. Inch.	Minutes Elapsed.
4.5	740	840	790	740	—	—	5
4.10	830	920	900	830	—	—	10
4.15	870	1000	980	880	—	—	15
	(465·5)	(537·7)	(526·6)	(471·1)			
4.20	950	1070	1050	950	—	—	20
4.25	980	1080	1080	980	·10	·10	25
4.30	1020	1140	1130	1030	·10	·10	30
	(548·8)	(615·5)	(610·0)	(554·4)			
4.35	980	1120	1100	1000	·10	·10	35
4.40	1040	1240	1220	1080	·20	·20	40
4.45	1200	1320	1340	1250	·20	·20	45
	(648·8)	(715·5)	(726·6)	(676·6)			
4.50	1210	1340	1350	1240	·30	·30	50
4.55	1280	1410	1420	1320	·35	·35	55
5.0	1290	1420	1460	1330	·35	·40	60
	(698·8)	(771·1)	(793·3)	(721·1)			
5.5	1330	1280	1380	1370	·40	·40	65
5.10	1350	1300	1400	1400	·50	·50	70
5.15	1380	1320	1420	1440	·55	·55	75
	(748·8)	(715·5)	(771·1)	(782·2)			
5.20	1420	1450	1520	1420	·60	·60	80
5.25	1410	1420	1500	1440	·70	·70	85
5.30	1420	1480	1550	1450	·80	·80	90
	(771·1)	(804·4)	(843·3)	(787·7)			
5.35	1500	1450	1580	1500	·95	·90	95
5.40	1550	1480	1620	1560	1·10	1·10	100
5.45	1600	1540	1670	1600	1·20	1·10	105
	(871·1)	(837·7)	(910 0)	(871·1)			
5.50	1660	1580	1700	1610	1·30	1·25	110
5.55	1620	1620	1680	1630	1·50	1·40	115
6.0	1660	1680	1720	1630	1·70	1·55	120
	(871·1)	(915·5)	(937·7)	(887·7)			
6.5	1630	1650	1740	1640	1·90	1·70	125
6.10	1640	1680	1760	1650	2·00	1·80	130
6.15	1660	1700	1780	1700	2·20	1·90	135
	(904·4)	(926·6)	(971·1)	(926·6)			
6.20	1630	1700	1790	1660	2.30	2·00	140
6.25	1710	1710	1830	1750	2·50	2·10	145
6.30	1740	1700	1840	1780	2 60	2·20	150
	(948·8)	(926·6)	(1004·4)	(971·1)			

* Degrees in italics are Centigrade.

OBSERVATIONS AFTER TEST.

(*See Figs.* 10 *to* 13.)

On August 16th and 19th the photographs shown in Figs. 10 to 13 were taken.

On August 18th the load was removed.

Most of the plastering to the soffit of the floor had fallen.

In the southern portion of the hut six longitudinal bars were exposed and five transverse ones in the position where the jet principally struck.

The cement mortar between the blocks was disintegrated for about half-an inch (·01 *m.*).

The floor had deflected to a maximum in the centre of 3 in. (·07 *m.*).

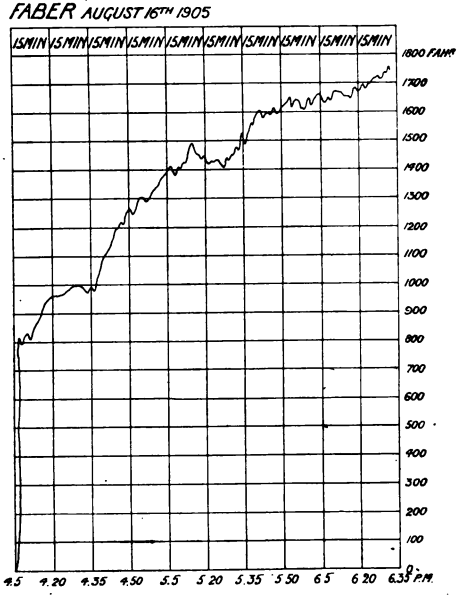
The upper surface of the floor showed one horizontal crack and nine transverse ones, with diagonal cracks at the four corners. (*See* Fig. 13.)

The terra-cotta blocks forming the floor were intact.

Neither fire nor water had passed through the floor.

TEMPERATURES—(CONTINUOUS RECORD).

The continuous record (Point No. 2) read as follows :—



GENERAL ARRANGEMENTS

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee of the Executive comprising :—

Mr. Ellis Marsland (District Surveyor, Camberwell), *Directing Member.*

Mr. E. J. A. Fulkes (Royal Insurance Co.).

Mr. J. Herbert Dyer (Vice-Pres. National Fire Brigades' Union).

Fig. 11. THE FLOOR VIEW AFTER TEST (FROM BELOW, LOOKING NORTH).

Mr. A. H. Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Council was represented for the testing operations of August 16th by—

Major-General E. Robert Festing, C.B., F.R.S.

The Executive was represented for the testing operations of August 16th by—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).
Mr. Oswald C. Wylson, F.R.I.B.A.
Mr. James Sheppard (Surveyor, Nth. Brit. and Merc. Ins. Co.).

Fig. 13. THE FLOOR. VIEW AFTER TEST (FROM ABOVE, AFTER REMOVAL OF LOAD).

The general body of members was represented for the testing operations of August 16th by—

Messrs. Walter Dewes, F.R.I.B.A.; E. J. A. Fulkes (Royal Insurance Co.); S. G. Gamble, A.M.Inst.C.E. (Divisional Officer, London Fire Brigade); Matt. Garbutt, F.R.I.B.A. (Metropolitan Railway); Robert P. Notley, F.R.I.B.A. (District Surveyor, Bethnal Green); Jos. Randall.

Messrs. Faber and Westphal were represented by—
Messrs. R. Faber, E. Faber, N. G. Pennington.

The following visitors attended the testing station by special invitation of the Executive, during the testing operations of August 16th :—

Messrs. C. Boreham (H.M. Patent Office); D. Christie; E. Catley (General Post Office); H. K. Dyson; A. R. Dyer. A.M.Inst.C.E. (Assistant Divisional Officer, London Fire Brigade); W. H. Francis; F. E. Gould; M. Gould; W. H. Growse; H. P. Gaze; E. Stokes Hand (New York, U.S.A.); Captain Horne; H. W. Monroe (H.M. Patent Office); Wm. Manning (Assistant Borough Surveyor. Chelsea); P. Mossop A. Moir (General Post Office); J. C. Stransom (Theatres Branch, L.C.C.); A. Schneider; Lieut. P. O. G. Usborne, R.E. (Royal Engineer's Institute, Chatham); Major J. R. Young, R.E. (Superintendent of Buildings, Woolwich Arsenal).

Signed,

For the Sub-Committee conducting the Test :—
ELLIS MARSLAND (*Directing Member*).

For the General Testing Arrangements Sub-Committee :—
J. HERBERT DYER.

For the Executive :—
JAMES SHEPPARD.

Published by the Committee as directed by the Executive.

C. F. ADAMI,
Asst. Secretary.

Date—September 25th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE-INNES, SON AND CRICK, *Solicitors.*

Date—October 3rd, 1905.

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"*RED BOOKS*" *of the*

BRITISH FIRE PREVENTION COMMITTEE.—No. 104.

Edited by the Executive.

FIRE TESTS WITH STANCHION ENCASEMENTS.

"TERRAWODE" ENCASEMENTS

FOR

STEEL STANCHIONS

ERECTED BY

MESSRS. JABEZ THOMPSON,

NORTHWICH, CHESHIRE.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897—Incorporated 1899),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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Fig. 14. STANCHION ENCASEMENT NO. 2 (AFTER TEST).

NOTE.

THIS is the first test of protective encasements to metal stanchions undertaken by the Committee.

Reliable protection for vertical metal structures being of supreme importance, the test is of exceptional interest.

The encasements under test for 2½ hours were of similar material to that used in the partition under test for 4 hours (as recorded in the Committee's publication, No. 84), and demonstrated that materials encasing an independent metal stanchion are subjected under the action of fire to far greater strain than when used in other positions. The test also proved that circular forms offer greater resistance to heat and fire than that afforded by similar material having exposed angles.

The test further showed that a height of as much as 12 in. for each course of an encasement and the arrangement of continuous joggle joints, are sources of weakness.

JAMES SHEPPARD.

November 22nd, 1905.

SOTHERAN

Fig. 9. THE TESTING CHAMBER (SHOWING LOAD).

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST No. 72—OCTOBER 25TH, 1905.

"TERRAWODE" ENCASEMENTS

FOR

STEEL STANCHIONS

ERECTED BY

MESSRS. JABEZ THOMPSON,

NORTHWICH, CHESHIRE.

OBJECT OF TEST.

To record the effect of a fire of 2½ hours' duration with a temperature gradually increasing to 1,800° Fahr. (982.2 *C.*), but not exceeding 2,100° Fahr. (1,148·8 *C.*), followed by the application of water for two minutes.

Note.—The time allowed for drying the encasements to the stanchions was 29 days (autumn).

Four variations of encasements, Nos. 1, 2, 3, 4, each 8 ft. 10 in. high (2·69 *m.*), were simultaneously under test, two square (Nos. 1 and 2) and two round (Nos. 3 and 4) respectively, No. 1, 4⅜ in. thick (0·111 *m.*), No. 2, 2½ in. thick (0·0635 *m.*), No. 3, 3 in. thick (0·076 *m.*), and No. 4, 2½ in. thick (0·0635 *m.*), the latter plastered, making together 3 in. thick (0·0762 *m.*).

SUMMARY OF TEST.

STANCHION ENCASEMENTS, NO. 1 (SQUARE). — The angles of several of the bricks encasing this stanchion split off or cracked, and the face of some of the bricks were splintered. The maximum temperature recorded between encasement and stanchion was 310° Fahr. (154·4 *C.*) after 150 minutes.

STANCHION ENCASEMENT, NO. 2 (SQUARE).—The tiles encasing this stanchion commenced to split at the angle joints after 45 minutes; this increased during the test, and some of the tiles were displaced, partly exposing the stanchion. The maximum temperature recorded between encasement and stanchion was 1,100° Fahr. (593·3 *C.*), after 150 minutes.

STANCHION ENCASEMENT, NO. 3 (ROUND).—Four of the tiles cracked vertically during the test. The maximum temperature recorded between the encasement and the stanchion was 500° Fahr. (260 *C.*), after 150 minutes.

STANCHION ENCASEMENT, NO. 4 (ROUND).—Surface of plastering flaked off. A local bulge of about 1 in. (·025 *m.*) for a height of 18 in. (·457 *m.*), appeared in the plastering of the encasement, 2 ft. (·61 *m.*) above floor level. The maximum temperature recorded between the encasement and stanchion was 590° Fahr. (310 *C.*) after 150 minutes.

The application of water washed off much of the plaster remaining on the encasement to stanchion No. 4, but had no effect that could be seen on the encasements to stanchions Nos. 1, 2, 3.

The steel stanchions in each case remained in position apparently unaffected.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4 *and* 9.)

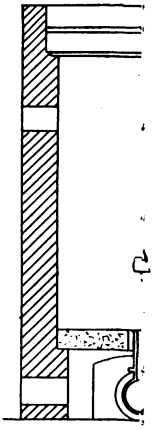
The testing chamber was located at the Committee's Testing Station, and was known as No. 1 Hut.

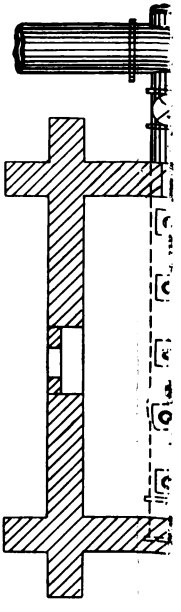
The hut was constructed, as shown, of bricks, built in lime mortar, and the portion used for this test measured 10 ft. by 10 ft. (3·048 *m.* by 3·048 *m.*). Stock bricks were used, except in the W. wall, where " Flettons " were used.

The ceiling was 8 ft. 10 in. (2·69 *m.*) above the pavement of the hut, and was constructed of concrete.

There was a door opening on the west side, measuring 2 ft. (·61 *m.*) by 6 ft. (1·83 *m.*), which was closed by being filled in with brickwork, 4½ in. (·114 *m.*) thick, except for an observation hole, which was covered by a movable iron shutter.

COLL





ENTS, NOS. I TO 4 *opp. page* 8.

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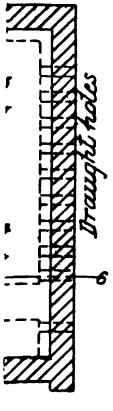


There were also observation holes in the E. and S. walls, the latter covered by a movable iron shutter.

The draught holes were in the E., W., and S. walls.

The fuel used was gas produced at the Station, and the supply was regulated by valves and dampers.

The gas was admitted through two mixing chambers of fire bricks, as shown.

Two Roberts-Austen pyrometers were used for recording temperatures, one to take observation records from seven points, Nos. 1, 2, 3, 4, 5, 6 and 7 points. Nos. 1, 2, 3 and 4 were in the air spaces between the stanchions, and their encasements about 7 ft. (2·133 *m.*) above the pavement of the hut. Point No. 8 was self-recording.

The photographs were taken by daylight.

Water was applied from a small steam fire engine through two branches each with a ½ in. nozzle (·0127 *m.*).

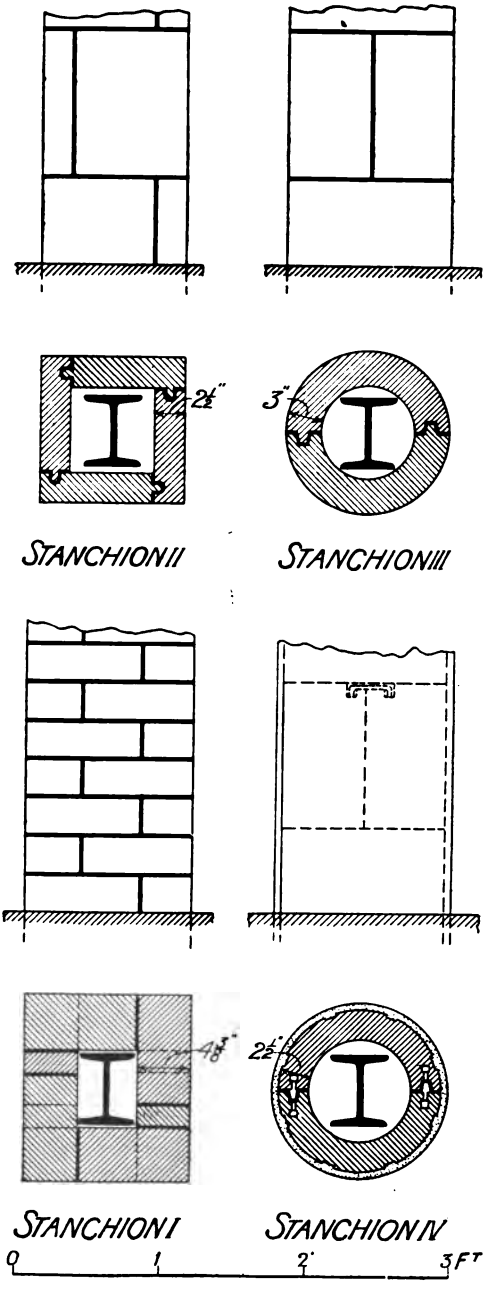
CONSTRUCTION OF THE ENCASEMENTS TO THE FOUR STEEL STANCHIONS.

(*Figs.* 1 *to* 8.)

The four stanchions (Nos. 1, 2, 3, 4) with their encasements were arranged as shown on Figs. 1 to 7.

The four stanchions were of steel, 6 in. by 4½ in. (0·152 by 0·114 *m.*), weighing 20 lb. per foot run (9·072 kilos per 0·305 *m.*), each having a total length of 13 ft. (3·962 *m.*). Angle irons, 4 in. by 4 in. by ⅜ in. thick (0·1016 by 0·1016 by 0·0095 *m.*), and plates ⅜ in. thick (0·0095 *m.*), were bolted to the stanchions to form bases and heads. The stanchions passed through the concrete floor of the hut and rested on rolled broad flange steel joists, 10 in. by 10 in. (·254 by ·254 *m.*), to which they were bolted; these joists passed across the hut, resting on a concrete foundation, and having bearings on the footings of the east and west walls. The stanchions also passed through the concrete ceiling, and their heads were bolted to a frame comprising three rolled steel joists, and two rolled steel channels, the joists being 10 in. by 5 in. (·254 by ·13 *m.*), and the channels 9¼ in. by 3½ in. (·235 *m.* by ·09 *m.*).

A load of baulks of timber and bricks was placed upon



Figs. 5 to 8. THE STANCHION ENCASEMENT. DETAILS OF NOS. 1 TO 4.

this frame so as to give a load of about three tons equally distributed on to each stanchion.

STANCHION No. 1 was encased with "Terrawode" bricks, 9 in. by 4⅜ in. by 3 in. (·228 *m.* by ·076 *m.*). The outside measurements of the encasings were 13½ in. by 15⅝ in. (·317 by ·396 *m.*). This was a square encasement, unplastered, 4⅜ in. thick (·111 *m.*).

STANCHION No. 2 was encased with square "Terrawode" tiles, 2½ in. (·0635 *m.*) thick, in four sections, having a continuous joggle at each vertical joint, the tiles as delivered measuring 9½ in. by 12 in. (·241 by ·305 *m.*). The outside measurements of the encasings were 12 in. by 12 in. (·305 *m.* by ·305 *m.*). This was a square encasement, unplastered, 2½ in. thick (·0635 *m.*).

STANCHION No. 3 was encased with circular "Terrawode" tiles, 3 in. (·0762 *m.*) thick in two sections, having a continuous joggle at each vertical joint, the tiles measuring 14½ in. (·368 *m.*), outside diameter, the height of the tiles being 12 in. (·305 *m.*). This was a round encasement, unplastered, 3 in. thick (·0762 *m.*).

STANCHION No. 4 was enclosed with circular "Terrawode" tiles, 2½ in. (·0635 *m.*) thick, in two sections, having a continuous joggle at each vertical joint, the outer diameter of the tiles measuring 13½ in. (·317 *m.*), the height of the tiles being 12 in. (·305 *m.*). Metal cramps were inserted in the beds at each joint. The outer face of the tiles was grooved for plaster and plastered with three coats of lime and hair mortar. This was a round 2½ in. (·0635 *m.*), encasement, plastered, in all 3 in. thick (·0762 *m.*).

The casing in each instance was bedded and jointed in mortar made with plaster of Paris, powdered fire clay and sand, in equal proportions.

The casing in each instance was bedded on the rolled steel joists below the floor upon which the stanchions rested, and thus passed through the floor.

The spaces between the stanchions and inner face of the casing was not filled in.

The height of the stanchions exposed to the fire was 8 ft. 10 in. (2·69 *m.*).

The hut was covered with tarpaulins placed over the load, which was removed an hour before the test.

The fixing of the four stanchions was completed on September 19th, 1905, and the load was imposed on September 20th, 1905.

The encasement of the stanchions was commenced on September 23rd, 1905, except the plastering of No. 4 encasement, which was completed on September 26th.

The concrete of floor and ceiling was made good round stanchions and encasements both at floor and ceiling level on September 27th, and the encasement of No. 4 thereupon plastered.

THE TEST.

On October 25th, 1905, the test was undertaken. The following is a log of the test.

At 9 a.m. the meteorological observations at the Royal Botanic Gardens, Regent's Park, read as follows :—

State of weather, overcast ; wind, N.N.E. ; barometer, 30·26 in. (·769 *m.*) ; attached thermometer, 43 deg. Fahr. (6·1 deg. *C.*) ; dry bulb, 36·5 deg. Fahr. (2·4 deg. *C.*) ; wet bulb, 36·0 deg. Fahr. (2·2 deg. *C.*). Raw cold morning.

a.m.	OBSERVATIONS.	Minutes elapsed.
10.30	The gas was lighted.	
10.31	Portions of the setting coat of plaster to No. 4 encasement flaked off.	1
10.35	Joints at angles of tiles at No. 2 encasement commenced to split at lower courses.	5
10.45	Angles of bricks to No. 1 encasement commenced to split slightly.	15
10.55	Further splitting at angles of No. 2 encasement. Setting coat on ceiling fell. Slight crack in tiles of No. 3 encasement.	25
11.0	Cracks in No. 2 encasement had opened to about 1 in. (·025 *m.*), and portions of the tile at eighth course from top had fallen. Steam passed through ceiling round stanchions Nos. 3 and 4.	30

		Minutes elapsed.
11.10	Between 11 and 11.10 a.m crack in the tiles of No 2 encasement increased in number and extent, and the whole bulged westward about 2 in. (·0508 *m.*), but returned nearly to its original line.	40
11.15	The three lower courses of the tiles on S.W. side of No. 3 encasement cracked a ¼ in. (·0063 *m.*), otherwise sound. Continued fall of plastering from No. 4 encasement and ceiling.	45
11.45	Steam passed freely between the concrete ceiling and walls of hut, and also between concrete ceiling and stanchions Nos. 3 and 4.	75
12 noon.	The hand could be held against the portion of stanchions above roof of hut.	90
p.m.		
12.15	Temperature of stanchion about roof No. 1, 75 deg. F. (23·8 *C.*), No. 2, 83 deg. F. (28·3 *C.*).	105
12.27	Crack to encasement to No. 3 stanchion had increased.	140
1.0	No further change appeared. Gas turned off.	150
1.3	Water applied from 2 branches with ½ in. (·027 *m.*) nozzle, with a pressure of about 45 lb. (3.06 atms.), one branch being applied to encasements Nos. 1 and 2, and the other to Nos. 3 and 4.	
1.5	Water turned off. No change appeared to have occurred in the encasements, but plastering was washed off No. 4 encasement.	

OBSERVATIONS AFTER THE TEST.

(*Figs.* 10 *to* 14.)

On October 28th the following observations were made :—

STANCHION ENCASEMENT TO NO. 1 (Square).—Bricks split at angles, and portion of face flaked off.

STANCHION ENCASEMENT TO NO. 2 (Square).—Tiles much broken at joggles and angles. Portions of some of the tiles fallen and others displaced.

STANCHION ENCASEMENT TO No. 3 (Round).—Some of the circular tiles split, but all in position.

STANCHION ENCASEMENT TO No. 4 (Round).—Plastering flaked or washed off. A bulge in the tiles, 18 in. in height (·457 *m.*), about 2 ft. (·609 *m.*) above the floor. All plastering friable. All steel stanchions in position on the removal of encasement they were found to be unaffected.

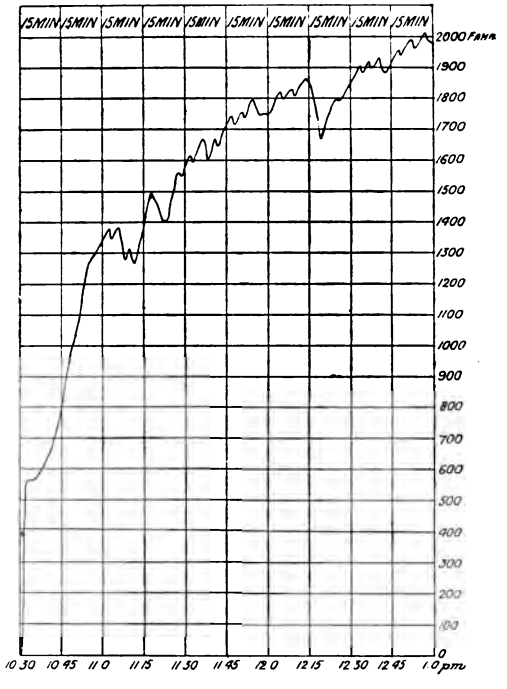
TEMPERATURES.

The following are the temperatures from Points Nos. 1 to 4 and Nos. 5 to 7:—

TIME.	POINTS IN TESTING CHAMBER.			POINTS BETWEEN STANCHION AND ENCASEMENTS.				MINUTES ELAPSED
	5	6	7	1	2	3	4	
a.m.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	
10.35	550	660	600	—	—	—	—	5
10.40	600	720	640	—	—	—	—	10
10.45	740	840	750	—	—	—	—	15
	(393·3)	(448·8)	(398·8)	—	—	—	—	
10.50	900	1020	920	—	—	—	—	20
10.55	1120	1210	1080	—	—	—	—	25
11.0	1315	1400	1310	120	330	210	250	30
	(712·7)	(760·0)	(710 0)	(48·8)	(165·5)	(98·8)	(121·1)	
11.5	1340	1420	1300	200	460	300	210	35
11.10	1300	1350	1300	200	505	280	305	40
11.15	1340	1360	1310	220	550	300	310	45
	(726 6)	(737·7)	(710·0)	(104·4)	(287·7)	(148·8)	(154·4)	
11.20	1380	1400	1340	220	550	230	280	50
11.25	1400	1420	1400	250	540	280	300	55
11.30	1450	1500	1520	240	550	250	280	60
	(787·7)	(815·5)	(826 6)	(115·5)	(287·7)	(121·1)	(137·7)	
11.35	1580	1620	1610	305	640	301	305	65
11.40	1560	1610	1600	260	665	270	260	70
11.45	1600	1660	1630	310	705	295	300	75
	(871·1)	(871·1)	(887·7)	(154·4)	(373·8)	(146·1)	(148·8)	
11.50	1620	1680	1690	290	730	290	305	80
11.55	1640	1730	1720	300	735	385	300	85
12.0	1660	1750	1760	300	760	305	305	90
	(904·4)	(954·4)	(960·0)	(148·8)	(404·4)	(151·6)	(151·6)	
p.m.								
12.5	1650	1720	1730	290	770	300	300	95
12.10	1620	1670	1650	295	790	260	285	100
12.15	1660	1700	1740	300	805	260	300	105
	(904 4)	(926·6)	(948·8)	(148·8)	(429·4)	(126·6)	(148·8)	
12.20	1630	1650	1620	300	830	290	350	110
12.25	1640	1700	1680	305	900	295	400	115
12.30	1700	1780	1750	300	905	275	410	120
	(926·6)	(971·1)	(954·4)	(148·8)	(485·0)	(135·0)	(210·0)	
12.35	1760	1840	1840	305	960	290	440	125
12.40	1800	1880	1900	300	1020	375	480	130
12.45	1840	1890	1920	310	1080	420	500	135
	(1004·4)	(1032·2)	(1048·8)	(154·4)	(582·2)	(215 5)	(260 0)	
12.50	1850	1900	1940	300	1080	460	510	140
12.55	1860	1920	1940	300	1105	485	560	145
1.0	1885	1950	1940	310	1100	500	590	150
	(1029·4)	(1065·5)	(1060·0)	(154·4)	(593·3)	(260·0)	(310·0)	

* Degrees in Italics are Centigrade.

The following is the diagram taken from the continuous record of the temperatures at Point No. 8 :—



GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee, comprising—

Mr. James Sheppard, A.Inst.E.E. (Surveyor, North British and Mercantile Insurance Company), *Directing Member.*

Mr. Percy Collins.

Mr. Matt. Garbutt, A.R.I.B.A. (Metropolitan Railway).

Mr. Ellis Marsland (District Surveyor, Camberwell).

Mr. A. H. Lister assisted the Sub-Committee.

Mr. A. H. White, M.Inst.E.E., superintended in the Instrument Room.

The Council was represented for testing operations of October 25th, 1905, by—

Major-General E. Robert Festing, C.B., F.R.S.

Mr. W. T. Hatch, M.Inst.C.E. (Chief Eng. Met. Asylums Bd.).

The Executive was represented for the testing operations of October 25th, 1905, by—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).

Mr. J. Herbert Dyer (Vice-Pres. Nat. Fire Brigades' Union).

Mr. Max Clarke, F.R.I.B.A.

The general body of members was represented for the testing operations of October 25th, 1905, by—

Messrs. J. Custodis, E. J. A. Fulkes (Royal Insurance Company); S. G. Gamble, (Divisional Officer, London Fire Brigade); Mr. Robert P. Notley, F.R.I.B.A., (District Surveyor, Bethnal Green); and Commandant Welsch (Ghent).

Messrs. Jabez Thompson were represented by—

Messrs. Sydney A. Hunter, A. E. Thompson, John J. Thompson, and a representative of Messrs. Lee and Eastwood.

The following visitors attended at the Testing Station, by special invitation of the Executive, during the testing operations of October 25th, 1905, by :—

Messrs. A. Ashbridge (District Surveyor, Marylebone), F. A. Baxter, S. Bylander, A. H. Cochrane, H. K. Dyson, Preston Davies, J. H. Dales, C.E., Reginald C. Fry, Harley Heckford, J. S. Peacock, T. Sterling, F. J. Walker (Central Electric Supply Co.), Sydney Watson, and a representative of the Sup. Architect, L.C.C.

Signed,

For the Sub-Committee conducting the Test :—
JAMES SHEPPARD, (*Directing Member*).

For the General Arrangements Sub-Committee :—
ELLIS MARSLAND.

For the Executive :—
J. HERBERT DYER.

Published by the Committee as directed by the Executive.

C. F. ADAMI
(*Assist. Secretary*).

Date—November 27th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).

Date—December 4th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

SOUTHWOOD, SMITH & CO., LTD., LONDON, E.C.

"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 105.

Edited by the Executive.

FIRE TESTS WITH CEILINGS.

A 2-in. Ceiling

FORMED WITH

"KULM" PUMICE CEILING SLABS

ERECTED BY

MESSRS. HORACE W. CULLUM & CO.,

LONDON.

The Committee's Report.

ALL RIGHTS RESERVED.

LONDON, 1905.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1897— incorporated 1899),
1, WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence.

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

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SIR JAMES WILLIAMSON, C.B., Director of H.M. Dockyards.
SIR HENRY TRUEMAN WOOD, M.A., Secretary, Society of Arts.

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(CHARLES ADAMI, *Assistant Secretary.*)

Fig. 8. THE CEILING, VIEWED FROM THE TOP AFTER REMOVAL OF FLOOR BOARDS (AFTER TEST).

NOTE.

THE result of this test shows that it is possible to efficiently protect a wooden floor of ordinary construction for three-quarters of an hour by means of a 2-in. pumice slab ceiling screwed to the underside of it.

Such a protection would be of the greatest value in old wooden buildings where economic reasons prohibit reconstruction on sounder fire-resisting principles.

OSWALD C. WYLSON.

LONDON,

November 15th, 1905.

THE GENERAL ARRANGEMENTS FOR TESTS.

(MEMORANDUM.)

THE purpose of the tests undertaken by the British Fire Prevention Committee is to obtain reliable data as to the exact fire-resistance of the various materials and systems of construction used in building practice and to give precise particulars regarding fire-alarm or fire-extinguishing appliances.

The tests are of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability is assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas.

All reports on tests solely state the bare facts and occurrences, with tables, diagrams, and illustrations, and on no account are reports to be taken as including expressions of opinion, nor should any expression be read as a comparison or criticism.

The general arrangement and direction of the tests are in the hands of the Executive, who act in accordance with certain principles laid down after careful study and experiment. The official tests are attended by the members of the Council and the members of the Committee in rotation.

The testing station comprises a house standing in its own grounds, the building being used for Committee rooms and the gardens utilised for the testing chambers and furnaces.

Parties interested in fire-resisting materials, systems of construction, or appliances, can apply for tests subject to a scale of charges, which varies according to the subject put forward for investigation and the preparations necessary. These charges are intended to cover in part or whole the expenses incurred upon the tests after due allowance for the establishment charges incurred in the maintenance of the station, the cost of the issue of the official illustrated report of the test to the members of the Committee, and the general clerical labour, etc., involved.

The actual *skilled conduct and supervision of the tests, as also the preparation of the reports by the members, is undertaken voluntarily;* no fees of any kind, or even out-of-pocket expenses, being paid to the members of the Committee for such services.

For the Executive,

EDWIN O. SACHS, *Chairman.*

January, 1905.

OFFICIAL REPORTS

OF THE

British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899].

FIRE TEST NO. 73—OCTOBER 24TH, 1905.

A 2-in. CEILING

FORMED WITH

"KULM" PUMICE CEILING SLABS

ERECTED BY

MESSRS. HORACE W. CULLUM & CO.,

LONDON.

OBJECT OF TEST.

To record the effect of a fire of three-quarters of an hour's duration with a gradually increasing temperature to 1,500° Fahr. (815·5° *C.*), but not exceeding 1800° Fahr. (982·2° *C.*), followed by the application of water for two minutes, with the view to classification as affording "Temporary protection" (Class A).

Note.—The area of the ceiling under investigation was 100 ft. super in the clear (9·29 *sq. m.*) *i.e.*, 10 ft. by 10 ft. (3·048 *m.* by 3·048 *m.*), screwed up to a floor of ordinary wood floor joists, the ceiling slabs being 2 in. (·051 *m.*) thick.

SUMMARY OF EFFECT.

No perceptible difference in the ceiling was observed during the progress of the test, except some slight cracks following the directions of joints of slabs, and between the ceiling and the wall of the hut all round.

On the application of water a large portion of the setting coat fell away from the ceiling, but the slabs remained in position.

On examination after the test, the wood joists to which the ceiling was attached were found to be intact, there being no charring, scorching, or other effect produced on them.

There was no sagging of the ceiling, which remained fixed tightly up to the underside of the joists.

Neither fire, smoke, nor water passed through the ceiling which remained in position at the conclusion of the test.

DESCRIPTION OF TESTING PLANT.

(*See Figs.* 1 *to* 4.)

The Testing Chamber was located at the Committee's New Testing Station, known as "No. 1 Hut (*a*)," being the northern portion of hut No. 1.

The hut was constructed as shown of stock bricks and lime mortar. The portion used for this test measured internally 10 ft. by 10 ft. (3·048 *m.* by 3·048 *m.*), and was separated from the other portion of the hut by a wall of stock bricks in lime mortar 9 in. (·229 *m.*) thick.

The opening in the west wall of the chamber measured 2 ft. by 6 ft. 6 in. (·61 *m.* by 1·98 *m.*), but was bricked up except for an observation hole.

There was an observation hole in the north wall, and two observation holes in the east wall.

The fuel used was gas produced at the station, the supply being regulated by valves and dampers.

The gas was admitted into the testing chamber through a honeycomb of fire bricks, as shown.

Two Roberts-Austen pyrometers were used for recording the temperatures, the instruments being used for the observation records at points 7 and 8, and for continuous record at point 6.

There were ventilation holes in the upper portions of both the northern and eastern walls of the chambers.

The photographs were taken by daylight.

The stream of water was applied through a hose and branch with $\frac{3}{4}$ in. (·019 *m.*) nozzle, supplied from a small steam fire engine equipped with a pressure gauge.

CONSTRUCTION OF THE CEILING.

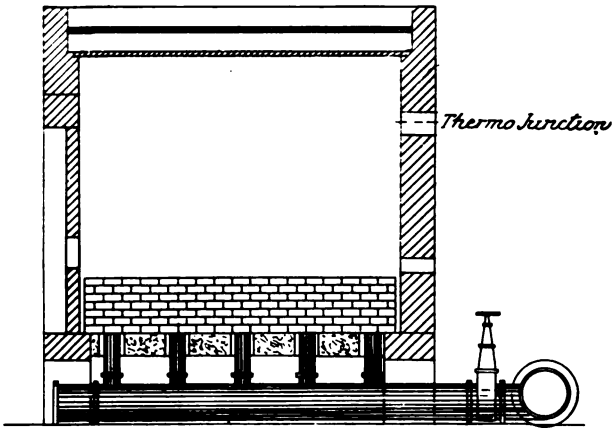
(*See Figs.* 1 *to* 6.)

The ceiling was constructed with eight 7 in. by 3 in. (·177 *m.*

EST).

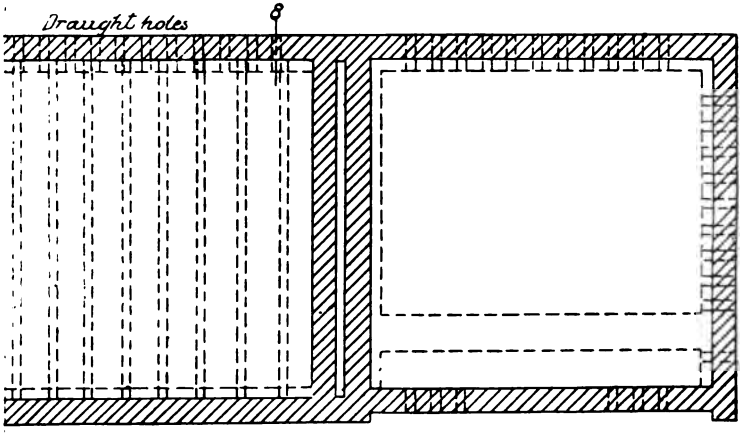
7.

Obs.



CROSS SECTION

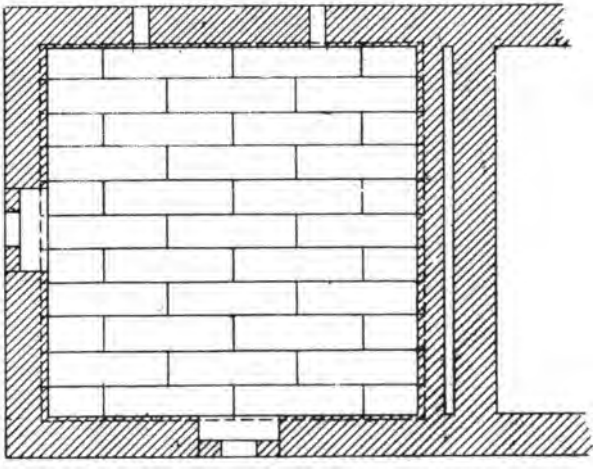
NOTE The points marked 6 7 8 are thermo junctions attached to wires leading to Pyrometers No 6 is self recording



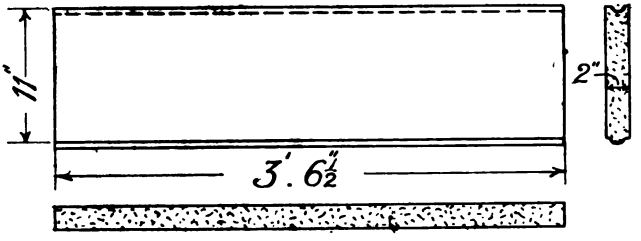
ROOF PLAN

ND SECTIONS.

by ·076 *m.*) fir joists, spaced about 14 in. (·35 *m.*) from centre to centre, and was 8 ft. 6 in. (2·59 *m.*) above the floor of the chamber.



PLAN OF CEILING LOOKING UP



DETAIL OF SLAB

Figs. 5 *and* 6.

To the underside of these joists "Kulm" pumice slabs, measuring 3 ft. 6½ in. by 11 in. (1·08 *m.* by ·28 *m.*), 2 in. thick (·05 *m.*) were screwed up with iron screws, 5 in. long (·127 *m.*), and ¼ in. (·006 *m.*) diameter, some of which had

galvanized washers, $\frac{7}{8}$ in. (·022 *m.*) in diameter, countersunk about $\frac{1}{2}$ in. (.012 *m.*).

The slabs were ceiled on the underside with plaster composed of fireclay, sand, and plaster of Paris (in equal parts) and the joints of the slabs on the top surface were grouted with similar plaster. The edges of the slabs were grooved into the walls all round about $1\frac{1}{2}$ in. to 2 in. (·038 *m.* to ·05 *m.*).

The joists were laid with a floor composed of $1\frac{1}{4}$ in. (·031 *m.*) rough boards with straight joints, and an additional layer of $1\frac{1}{4}$ in. (·031 *m.*) rough boards was placed on the last mentioned, laid to break joint.

The ceiling was completed on September 20th, 1905.

For ten days prior to the test, a coke fire was kept alight in the Testing Chamber

THE TEST.

The test was made on Tuesday, October 24th, 1905, the following being a log of the Test :—

At 3 p.m., the meteorological observations taken at the Botanic Gardens, Regent's Park, read as follows :—

State of weather, overcast; wind, N.N.E.; barometer (corrected) 30·15 in. (0·77*m.*); attached thermometer, 45·5 Fahr. (7·5 *C.*); dry bulb, 44·0 Fahr. (6·6 *C.*); wet bulb, 41·2 Fahr. (5·1 *C.*).

Remarks : Dull, cold day.

OBSERVATIONS.		Minutes Elapsed.
1.15 p.m.	Gas was lighted and test commenced.	
1.29 p.m.	Dark lines commenced appearing in the directions of the joints of slabs.	14
1.32 p.m.	Dark lines commencing to slightly crack.	17
1.35 p.m.	Small portions of the setting coat of plaster began peeling off in places.	20
1.36 p.m.	Hair cracks appearing over the surface of ceiling.	21
1.45 p.m.	Crack appearing around wall of the S.E. angle and against W. wall.	30

OBSERVATIONS.—*Continued.*

		Minutes Elapsed
1.50 p.m.	Crack against wall extending around wall of hut.	35
1.58 p.m.	The setting coat of ceiling was covered with hair cracks following the directions of joints of slabs and transverse to same.	43
2.0 p.m.	Gas was turned off.	45
2.2 p.m.	Water was applied for two minutes through opening in north side of hut from a ¾ in. nozzle (0·019 *m.*) with a pressure of about 60 lb. (4·08 *atms.*) to the underside of the ceiling.	47
2.4 p.m.	Water was turned off.	49
	The effect of the water where it struck was to wash off the plastering, and to expose the joints of some of the slabs in the centre. (*See Fig. 7.*)	

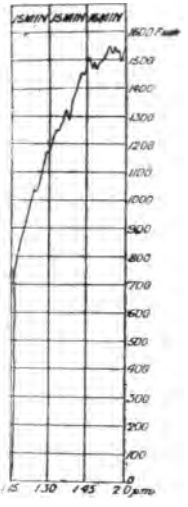
TEMPERATURES.

The temperatures read from observation records off pyrometer junction points No. 7 and No. 8 were as follows :—

Time.	No. 7.	No. 8.	Minutes Elapsed.
p.m.	Fahr.	Fahr.	
1.20	900	760	5
1.25	1100	1020	10
1.30	1165	1140	15
	(*629·4*)	(*615·5*)	
1.35	1320	1280	20
1.40	1360	1360	25
1.45	1420	1440	30
	(*771·1*)	(*782·2*)	
1.50	1480	1460	35
1.55	1540	1540	40
2.0	1600	1600	45
	(*871·1*)	(*871·1*)	

* Degrees in italics are Centigrade.

The continuous record (Point No. 6) read as follows:—



OBSERVATIONS AFTER TEST—OCTOBER 25 AND 28.

(*See Figs. 7 and 8.*)

INSIDE.—The plastering that remained had hair cracks all over the surface in the direction of the joints of the slabs.

About 2 yds. super (1·67 *sq. m.*) of the plaster had fallen where struck by the jet, and the exposed surface of the slabs was slightly damaged.

In two places the plastering in joints had completely gone, leaving small holes right through the plaster. There were no apparent cracks in the slabs.

OUTSIDE.—No fire, smoke or water has passed through the ceiling.

The joists and floor boards were perfectly intact, and showed no signs of charring or discolouration.

GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description,

and was conducted by a Sub-Committee of the Executive, comprising :—

Mr. Oswald C. Wylson, F.R.I.B.A., *Directing Member.*
Mr. Ellis Marsland (District Surveyor Camberwell).
Mr. J. Herbert Dyer (Vice-President National Fire Brigades' Union).

Mr. A. H Lister assisted the Sub-Committee.

Mr. H. B. White, M.Inst.E.E., superintended in the Instrument Room.

The Executive was represented for the testing operations of October 24th by—

Mr. Edwin O. Sachs, F.R.S.Ed. (*Chairman*).
Mr. Max Clarke, F.R.I.B.A.
Mr. Percy Collins.
Mr. James Sheppard, A.Inst.E.E. (Surveyor, North British and Mercantile Insurance Company).
Mr. J. W. Restler, M.Inst.C.E. (Metropolitan Water Board).

The general body of members was represented during the testing operations of October 24th by—

Messrs. Bernard Dicksee, A.R.I.B.A. (District Surveyor, East Newington, etc.); E. J. A. Fulkes (Royal Insurance Company); Matt. Garbutt, A.R.I.B.A. (Metropolitan Railway); Louis T. Healy (Royal Insurance Company); Lieut. S. Sladen, R.N. (Divisional Officer, London Fire Brigade); H. H. Statham, F.R.I.B.A.; A. T. Walmisley, M.Inst.C.E. (Engineer, Dover Harbour Board); Commandant Welsch (Ghent); Lieut.-Col. J. Winn, R.E., A.Inst.C.E.

The Commercial Section of "subscribers" was represented for the testing operations of October 24th by—

Messrs. W. H. Aston and W. Sandwell (Messrs. G. Aston and Sons); E. Homan (Messrs. Homan and Rodgers).

Messrs. H. W. Cullum and Co. were represented by Messrs. H. W. Cullum and C. A. Hood.

The following visitors attended at the Testing Station by special invitation of the Executive, during the testing operations of October 24th—

Messrs R. Allison (H.M. Office of Works); Colonel Bagnold, R.E. (H.M. Ordnance Factories, Woolwich); V. Brand; C. F. Boreham (H.M. Patent Office); C. McArthur Butler

(Secretary, Society of Architects); F. A. Baxter; Major A. J. Craven, R.E. (War Office); J. C. Custodis, C.E.; Edmond Coignet (Paris); A.R.Dyer, A.M.Inst.C.E. (Assistant Divisional Officer London Fire Brigade); H. K. Dyson; J. H. Dales, A.M.Inst.C.E.; V. E. Faber; C. H. Freeman; F. A. Hawkins; A. P. Lander; G. A. Lansdowne; F. Morgan; H. W. Monroe (H.M. Patent Office); Chas. H. Mead; Alex. Moir (General Post Office); B. B. Middleton; H. Parsons; C. H. Reynolds (Crown Agents' Office); T. Sterling; W. Sackfield (H.M. Patent Office); Captain E. N. Stockley, R.E. (War Office); G. Terrill; J. C. Stransom's Deputy (Theatres Branch, L.C.C.); W. N. Twelvetrees; F. Walker (Central Electric Supply Company); G. C. Workman; Major J. R. Young, R.E. (Superintendent of Buildings, Woolwich Arsenal); Captain C. E. Vickers, R.E. (War Office); and a representative of the Superintending Architect, L.C.C.

Signed,

For the Sub-Committee conducting the Test :—
OSWALD C. WYLSON, *Directing Member.*

For the General Testing Arrangements Sub-Committee :—
J. HERBERT DYER.

For the Executive :—
ELLIS MARSLAND.

Published by the Committee as directed by the Executive,

C. F. ADAMI
(*Assist. Secretary*).
Date—November 24th, 1905.

Verified a true copy of the Report ordered to be published.

ROSE, INNES, SON AND CRICK (*Solicitors*).
Date—December 4th, 1905.

Lists of the Committee's Publications, Contents of the Committee's Journal, etc., are obtainable upon application to the Assistant Secretary, 1, Waterloo Place, Pall Mall, London, S.W.

POINTS REGARDING THE COMMITTEE.

The British Fire Prevention Committee is now over eight years old, having been founded shortly after the Cripplegate Fire of 1897. *Its incorporation dates from* 1899.

During this period the Committee has actively pursued its experiments and investigations with ordinary and proprietary building materials and methods of construction, as well as with other inventions intended to prevent the outbreak or spread of fire.

The four series of tests, highly valuable to those who are interested in the safety of warehouses, shops, factories, etc., are :—

I. Tests with fire-resisting doors ;
II. Tests with fire-resisting floors ;
III. Tests with fire-resisting partitions ;
IV. Tests with fire-resisting glazing.

Had the lessons of these tests been more generally studied by the owners of property and their advisers, it is certain that an immense amount of fire loss might already have been avoided.

The Committee have prepared "Standards" of Fire Resistance, which have been adopted as Universal Standards throughout Europe.

The Reports on the Committee's tests and its Ordinary Publications are in the form of fully illustrated 8vo *"Red Books," of which* 100 *have already appeared. As soon as each "Red Book" is printed, a copy of it is despatched to every Member and Subscriber.*

The Committee's Quarterly Journal is 4to *size, and generally comprises some* 50 *pages of original matter, frequently profusely illustrated.*

One of the most notable events in the history of the Committee was the convocation of the International Fire Prevention Congress, opened by the Right Hon. the Lord Mayor of London, July 6th, 1903, *which was attended by* 840 *members from all parts of the world, including numerous officially appointed representatives from Home, Colonial, and Foreign Governments, municipalities, and public bodies. The valuable papers read thereat by the greatest authorities from all nations have been collected in a handsome volume.*

His Majesty the King sent the following message to the Congress :—

"The King sincerely trusts that the deliberations of this important and representative body will lead to a further development as to the best means to be adopted in regard to the prevention of fire, and to the saving of life in cases of fire."

At the same time, there was organised under the auspices of the Committee, and opened by H.R.H. the Duke of Cambridge, an International Fire Exhibition, at which the leading British and Continental manufacturers exhibited, and a most interesting Loan Collection was got together, comprising exhibits, and telling in a striking manner the history of fire prevention and fire fighting from the earliest times to the present day.

The International Fire Library, which is being formed by the Committee, already includes over 2,500 *items, many of great importance.*

For particulars as to Membership or enrolment on the List of Subscribers, apply to the Assistant Secretary, No. 1, Waterloo Place, Pall Mall, London, S.W.